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NOTICE TO AMERICAN READERS.

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NOTICES.

The subscription is 10s. per annum if paid in advance, or 12s. on credit, payable in two sums of 6s. each, due in June and December of each year. All subscriptions commence from the 10th of January.

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Back numbers exceeding three months' date will in future be charged double price, unless six or more consecutive numbers are taken at the same time. Nos. 6 and 18 are out of print.

The Editor will be particularly obliged by his friends forwarding to him Notices of all Meetings, Trials, or Appeals which it may be interesting to the Gas World to have reported.

AVIS

A MM. les Exposants étrangers de l'Exposition de l'année 1851.

Le Rédacteur du Journal d'Eclairage au Gaz a l'honneur d'annoncer aux inventeurs et propriétaires d'appareils pour la fabrication, distribution, et les emplois à l'usage du gaz, qu'il est pret a se charger de leurs intérêts, pour la grand exposition internationale de l'année prochaine. S'addresser franco au Rédacteur du Journal, 32, Bucklersbury, à Londres.

Circular to Gas Companies.

The Editor may be consulted on all subjects connected with the supply and manufacture of gas, or the alteration and improvement of gas apparatus, and the construction of new works.

The competition between some of the rival gas companies, from the continuance of which the citizens of London expected so much, has already reached that stage which every one acquainted with the history of such descriptions of warfare predicted it would, sooner or later, arrive at, though few anticipated the realization of the event after a short campaign of only five months' duration. The public, as well as ourselves, were startled by an announcement in the morning papers of the 6th inst. to the following effect:—

"Great Central Gas Consumers' Company,
28, Coleman-street, City, March, 1851.

"Notice is hereby given, that a Special General Meeting of the Shareholders of this Company will be held on Monday, the 17th day of this present month of March, at Six o'clock in the evening precisely, at the London Tavern, Bishopsgate-street, within the City of London, to take into consideration the proposal of the City of London Gas Light and Coke Company to amalgamate with this Company, and, if such proposal be agreed to, to assent to clauses being inserted in this Company's Bill, now before Parliament, to facilitate the arrangements for carrying the Bill into effect.

"By order of the Board,
"R. M. Massey, Secretary."

Rumours had, indeed, been current for some weeks past that the Great Central Company, anxious to avoid the exposure which a parliamentary opposition would have produced of their affairs and position, were taking all possible means to neutralize or to procure the withdrawal of the numerous petitions against them presented to the Legislature, and that, so far as several of the gas companies were concerned, they had succeeded, by pledging themselves not to extend their mains beyond their present limits. The City of London Gas Company remained inexorable, partly because their opponents had already overrun the whole of their district within the limits of the City, and there was consequently no sop to offer them in the shape of a cessation from further aggression, and partly from personal rivalry between several of the parties connected with the respective bodies. What arrangement may be ultimately come to, or whether any at all, time alone can solve. It is to be hoped that no weakness or vacillation will now occur to change that policy which dictated the rejection of all offers of a compromise, under the influence of the resolution of Mr. Cardwell's committee, a policy the adoption of which many *then* deplored, though they would be the last *now* to advise the abandonment of it. The capitals and liabilities of the two bodies cannot be taken at less than £500,000, an amount upon which it is certain the supply of gas of a fair quality at 4s. per 1000 is quite inadequate to pay even a 5 per cent. dividend. Whether an improvement of 50 per cent. in the quality, and an augmentation of 25 per cent. on the price, might not be effected with advantage, both to the consumers and to the gas companies, are matters worthy of their serious consideration, and that of every other metropolitan gas company, before another shilling is expended in extension of works.

We have elsewhere devoted a considerable space to a record of some of the late triumphs and tribulations of the hydro-carbon abortion. The melancholy termination of the life of one so valued by his friends as was Mr. Hodgetts possesses a mournful interest to all, but more especially to the writer of this, to whom, within a few hours of his terrible end, he had addressed a letter full of hope of the prospective success of the experiment he was then about commencing, to which Providence, however, decreed an unexpected termination. The reply, written on the eve of the catastrophe, could scarcely have reached him when overtaken by the disaster which hurried him into eternity. Many of our readers will not have forgotten his interesting letter in support of this system of gas-making inserted in the Journal for September last, nor the tribute we then paid to its intelligence and good sense, as opposed to the absurd statements of the projector of the scheme. Since then many private communications have passed between us, all marked on his part with the same candour and determination not to misrepresent, while vigorously supporting his own views and interests. Such an adversary is entitled to our respect, however much we may disagree with him; and we willingly add ours to the many other testimonals to his worth and talents which his awful death has called forth.

The accident is attributed, by the principal witness examined at the inquest, to the deposition of "paraffine" in the leaden worm of the still, by which the passage for the exit of the products of the distillation was closed, and, on the water being withdrawn from the vat, such an augmentation of the temperature is presumed to have taken place as affected the strength of the lead to resist the pressure within the worm, which consequently burst. It is, however, quite certain that no paraffine would be deposited under such circumstances, but that naphthaline would be produced in large quantities; and, if we are not misinformed, the unfortunate victim had been

cautioned against such a result. The more probable explanation is that by the pressure within, the cement was blown out of the socket-joint connecting the head with the body of the still, and, the vapour igniting, the whole was instantaneously in a blaze.

The construction of an apparatus liable to become so obstructed, without a safety pipe or valve, is evidence of a hardihood or ignorance, to which a verdict of "Accidental death" is but a mild rebuke. It is to be hoped that this will be the last life sacrificed in furthering such a project. Why not sell the material to persons accustomed to its use, and knowing how to manipulate it, rather than attempt to establish a fictitious value for it at the expense of human life and suffering? Manchester abounds with such manufacturers, who will gladly take it at what it is worth.

The experiment upon this gas itself, recorded in the *Manchester Guardian*, an extract from which follows the report of the accident, is interesting from two facts which it discloses; first, that Mr. White's 3½d. per 1000 feet (which in the April Journal of last year he stated to be the cost price of his gas) is now expanded into 1s. 8d., when wear and tear and labour are included; and, secondly, that half a cubic foot of it gives *a light equal to one standard candle* (it is presumed of 120 grains per hour), or 5 feet to 10 candles. It is remarkable that, whenever reference to this invention is made in the public prints, they all relate to experiments at places where the apparatus has been in use but a few weeks, or, at the utmost, two or three months. *Tout nouveau, tout beau*, is an old adage of our neighbours, and it is a failing common to human nature in general. Do Messrs. Schwabe and Co. coincide in the eulogium pronounced upon it by the more recent adventurers? Is the experience at the Queenwood College equally satisfactory? Are not the Southport people beginning to open their eyes and make inquiries as to the cost of coal gas? Was not the tar experiment at the Manchester Gas Works so complete a failure as to convince even Mr. Hodgetts that the gas so made cost six times as much as that from cannel coal, and was practically inferior to it in quality? Perhaps some of our readers can give authentic information upon these points, which may have more value than the incomplete details which are allowed to transpire through the columns of the local papers.

However, the facts are now admitted that the materials, labour, and wear and tear, for the manufacture of this gas, are contracted for by Mr. White in Manchester at 1s. 8d. per 1000 feet, but it is to be hoped that this contract is not based upon any treatment of the residuary products by which two or three victims are liable every now and then to be hurried into eternity, and that due precautions will for the future be taken to give warning to those employed when any danger threatens. Any neglect of this would justify a severe verdict should a second catastrophe occur.

Half a cubic foot of the gas thus made by contract is stated to have given a light equal to one standard candle, and, making due allowances for the unfavourable circumstances under which an experiment of this nature is performed, it is quite clear that there is nothing to boast of in respect of illuminating power. Our standard for Wigan cannel gas is 2·23 candles for the same quantity when burnt to the greatest advantage.

Communicated Articles.

THE PRICE OF GAS.

BY J. O. N. RUTTER, ESQ.

Why is gas sold at so many different prices? What are the conditions which influence its price? How can it be known if it be charged at a fair price?

To these several questions, and probably some others having a direct reference to the same subject, I shall endeavour to furnish, what I believe to be, satisfactory answers. Success is by no means certain. That kind of success so agreeable to a writer is scarcely to be hoped for in the present instance. It is new ground; and, whilst I feel that it ought to be broken up, I am not insensible to the difficulties which attend a first attempt. There are no secrets to disclose—no mysteries to reveal. All that relates to the price of gas appears to me to be exceedingly simple. I know of nothing which might not be easily understood by those who really wish for the information, and who are just the sort of persons to whom I address myself on the present occasion. Practical men, engaged in the manufacture and sale of gas, know all about these things, I had almost said, by intuition. They constantly occupy their thoughts, and necessarily become a part of their daily existence. The knowledge thus acquired, and the familiarity with details which naturally grows out of it, are, however, more frequently of a local, than a general, character. To this cause is to be attributed some of the mistakes which have lately been made, the misstatements which have been permitted to remain unanswered, and the unfavourable impressions produced on the minds of those who were willing to have received correct information. Those who ought to take the lead, and who expect to be looked up to for counsel, in these matters, should prepare themselves for their various forms of duty. Enlarging their spheres of observation, they must attentively watch the changes which are in progress; anticipating and preparing for their effects, as far as it may be practicable to do so, instead of waiting to witness their fuller development. In discussions, now so common, about the price of gas, there is as much necessity for reasons as for facts. The latter, however valuable when rightly interpreted, are very unsafe guides if separated from local conditions, and unsupported by actual experience.

With but little expectation of pleasing all classes of readers, it may not be too much to hope that some, at least, may be instructed. A new, and probably a right, direction might perchance be given to the thoughts of those who are inquiring, because they are interested, about the price of gas. If, by anything I shall say, they are shown how to prosecute their inquiries in a proper spirit, and where to seek for correct data, such small beginnings are sure to be diffusive. All that I have wished for will thus be accomplished: the truth will be known, and, when known, it must eventually prevail.

Before proceeding further, let me mention one or two things which, if left unexplained, may give occasion to doubt, if not to misapprehension. It must always be assumed that the price of gas in any given locality is not, or at any rate ought not, to be dependent on, or determined by, the cost of works, the amount of capital, the price of shares, or the rate of dividend which has been, or is now, paid thereon. These questions concern, and are of the utmost importance to, the proprietors; but the public in general, and the consumers of gas in particular, have no right to interfere with them. No such principle is recognised in the ordinary pursuits of life, whether of trade or manufactures. There are no laws or customs which apply exclusively to gas companies, either as conferring on them privileges, or as depriving them of rights.

If the works have been so long established, or so improperly managed, as to be supposed to have cost too much, or if the business has grown so slowly, or been conducted with so little spirit, as to have disappointed the just expectations of the projectors, the public ought not to be placed at a disadvantage. On the other hand—where circumstances have been favourable, the works from their first establishment fully occupied, the business constantly increasing, so as not only to realize, but greatly to surpass, the calculations of the proprietors, who will say that they are not fairly entitled to the rewards of their enterprise?

In fixing the price of gas, wherever the influences may in reality come from, whether pressure from without, or foresight and wise counsels from within, it is commonly believed that the cost of the works, and the profits realized, always decide the question. It is as generally believed that these are greater than they ought to be, and, consequently, that the price of gas is higher than is necessary. A vast deal of this is purely imaginary: only a very small portion of it deserves the name of reality. Gas companies have themselves to blame for these false notions. They have often put arguments into the mouths of their opponents. The delusion here referred to has been encouraged by the companies in talking too much about the money they have expended, the depreciation of their shares, and the low rate of their dividend. This is not the way to look at the matter. The question between gas companies and their customers is, not what price this or that company can afford to charge for gas, but what is a fair price for it in this or that particular locality.

In stating, as I have done, that the price of gas, in any given locality, ought not to be decided by a reference to the cost of works, the amount of capital, and the rate of dividend, I will try not to be misunderstood. Let it not be supposed that, the price can ever be properly ascertained, without recognising the cost of works as an important element in the calculations. It must not, however, be used as the primary element. As already hinted, in some instances this item may appear too great, and in others too small. The real object of inquiry would, therefore, soon escape notice; being mixed up with unprofitable, and at all times unsatisfactory, discussions about losses on the one side, and gains on the other. Here the question again presents itself—how is the proper price for gas to be ascertained? Wait a little; we shall come at that presently. Some errors still require to be cleared off. The truth will then be easily discerned.

In the disputes which have arisen about the price of gas, great mistakes have been committed on both sides. Gas companies have acted as if they were the sole depositaries of important secrets; whilst the public, adopting exactly an opposite course, have acted as if they understood the whole business of making and selling gas better than the companies. This has been, and still continues, too much the practice in managing these matters. There have been exceptions, but of comparatively rare occurrence; although always attended by results which, in the end, have proved advantageous to all parties.

These disputes, frequently conducted with the irritating incidents of a paper warfare, and the agitations and excitements of public meetings, are usually helped forward by exaggerated statements, prepared for such occasions by persons who are sure to gain something, whatever others may lose. Such statements, professedly the results of experience, and apparently supported by statistics of gas-lighting, collected from other parts of the kingdom, are readily received without examination. If carefully analyzed they would, in all their main features, be found irrelevant to the case under consideration. Conclusions hastily deduced are by one party believed to be true; by the other they are known to be altogether fallacious. Reasons, however plentiful, are now inadmissible; arguments, at other times convincing, are all thrown away. The opportunity, if it ever existed, for employing these to advantage has gone by. With the feelings thus brought into active operation it is not only difficult but impossible to arrive at a good understanding. The materials thus thrown upon the surface are the most unlikely in the world for constructing an equitable and a lasting agreement. On one side unreasonable demands are made, accompanied by threats as to the consequences of refusal. On the other side, with equally bad taste, opponents are taunted to do their worst; and so wounds are enlarged which it is the interest as well as the obvious policy of a gas company to endeavour to heal. Can there be any greater proofs of bad management? If both parties properly understood the business they took in hand, and were to go about it with a due regard to their respective interests and responsibilities, the results would be different. A little quiet talk, a few friendly meetings, some mutual explanations, and a disposition on both sides, within reasonable limits, to give way, would soon make that intelligible which otherwise remains involved in obscurity. By the exercise of kindness, of forbearance, of confidence, and of liberality, a great deal can be accomplished; and such measures will be more effective, in settling the price of gas at its (lowest) fair commercial rate, than those I have just before been describing. Both plans have been tried. Let the results in each case attest their respective values.

A gas company is by many persons viewed as a monopoly. It is easier to talk about this than to prove or maintain its existence. The original meaning of the term is scarcely known amongst us; and it can be applied to any large trader or manufacturer in the same town, or in the next street, with equal propriety as to a gas company. There is no need of inventing analogies when they are wanted, nor of trying to discover them where they do not exist. In many respects a gas company occupies exactly the same position as ordinary traders. In some things a private tradesman enjoys greater privileges; and in others, it is readily conceded, there are points of difference which appear to give a company an advantage. This is more in the nature of an incident in the process of manufacture, than anything worthy the name of an immunity. It is a hazardous, a costly, and, in some of its details, an offensive process. The security, as well as the convenience, of the public necessarily imposes restrictions upon gas companies, some of which are at times difficult to be complied with. Merchants, manufacturers, and traders of all classes are monopolists, if that mean the getting as much business, and making as much profit, as possible. All this is perfectly natural; the impulses of self-interest operating alike in all. Those who complain about the monopoly of a gas company forget, for a moment, how sensitive they are when a neighbour in the same trade carries off one of their own customers.

Now a few words about competition, its effect upon the price of gas, and of gas-lighting generally, and there will be no difficulty in replying to the questions placed at the beginning of this article.

To prevent mistake, I state explicitly my belief that, whilst competition has in some instances been necessary, and in others unavoidable, whatever has been done, or is now doing in the same town, by two companies, might be done equally well, and most likely better, by one. Holding by this principle as being practically right, if guarded by statutory regulations, I see no necessity for making exceptions in favour of towns or districts (not even the metropolis) where the magnitude of the operations may be supposed to mitigate the effects of competition. The limit of profitable capabilities, in the operations of a gas company, is geographical, not commercial. In the early days of gas-lighting, if companies had possessed more foresight, if they had better understood the duties they had undertaken, if they had relied less upon power and patronage, and more upon the resources placed at their command, if they had laboured diligently in developing the energies of the newly-born science—the world would not have waited forty years for it to be known and acknowledged that gas was one of the necessaries of life. With equal propriety it may be asserted that, if greater efforts had been employed to make the public understand the properties of gas—to hail as a blessing what they were so long advised to dread as a nuisance—there would now have been no disputes about what was a fair price for that article. If it be considered unnecessary to refer to errors and oversights, which are better forgotten because they cannot be remedied, I do it only with a hope that similar errors may in future be avoided. Old prejudices, relating to gas and gas companies, the profits they realize, and the prices they charge, are only in part subdued. A mere trifle is sufficient to set them at work again; when many foolish things would be enacted, and statements, which have been refuted a hundred times, would be as readily believed as if they consisted of the most simple and self-evident truths.

Competition in gas-lighting has not accomplished all that has been predicated, nor all that might have been expected, of it. In most cases its aid has been evoked amidst the heat and turmoil of disputation; conditions by no means favourable to caution in raising money, or to economy in spending it. Experience teaches that the same ends might have been attained by less costly means; provided a certain state of mind and of feeling had existed in those whose interests were at stake. Examples were necessary to bring about that kind of conviction which reasons and arguments, unaccompanied by persuasions from the pocket, always fail to produce. These examples have not been numerous, but they are very instructive. Without them it is improbable that the resources of gas-lighting would have been so ably illustrated, its benefits so widely diffused, or the price of gas so much reduced. We speak with confidence of what has been done, with hesitation of what might have been effected. There have been cases, where the intractibility of one or the other party, has so entirely closed the door against negotiation, that competition was necessary as the only defence against injustice. When all reasonable means have been tried, and have failed, events must shape their own course.

Still, it is a fact not undeserving of notice that new establishments, brought into existence under the most favourable circumstances, have never been very successful as competing companies. Injuring their elder neighbours, without doing any good to themselves, has been found as unsatisfying as it is unprofitable. Such proceedings wear themselves out; the very intensity of their action hastening exhaustion. Good sense and wiser counsels at length prevail, both parties having found out what they ought to have known long before—the wonderful difference there is between friendly and hostile competition. The drawing towards each other of rival companies, and the union of some of them which has recently been effected, confirm the opinion already expressed—that one company can serve the public, under suitable restrictions, better than two. It is in no respect connected with a desire, or an intention, to enhance the price of gas. That is impossible. The public have in their hands the remedy they possessed before, with all the advantages of after-knowledge to render it more effective. Where rivals have thus adjusted their differences, and united their interests, it has been union, but not, in its offensive sense, combination. The companies know, what their customers now readily believe, that one uniform system of management, and of manufacture, is better than two; the public being better served, the price being more likely to be, from time to time, reduced to a minimum rate, and many inconveniences, which need not here be enumerated, being thereby avoided.

In some undertakings, and in association with certain influences, it would seem that knowledge, even when fortified by experience, makes no lasting impression; that which has been attempted again and again, and has always failed, being tried exactly in the same way with the fullest assurances of success. With few exceptions, competition in gas-lighting has started upon insufficient, or incorrect, data. The difference between the estimated, and the actual, amount of money expended is a matter we have no need to dwell upon. Some of the old companies have nothing to boast about in that particular. The common error, pervading the preparatory processes of a rival establishment, consists in fixing too high a standard as to the amount, and profitable results, of the business which it is estimated will fall to the share of the young aspirant as soon as the works are completed. These expectations (?) and the promises founded upon them are never verified; and yet they are repeated with as much apparent confidence as if a wish and its realization were always found together. Whether there be anything connected with these pursuits to induce forgetfulness, or whether it be unnecessary or inconvenient to recognise original companies, I will not pretend to say. It certainly appears strange that no account is taken of the years they have laboured, the money they have expended, the business they have created, the influence they possess, the freedom of action they enjoy, and the probable effects of the provocations they have received, and of which they complain. To say the least of it, a slight is put upon an old establishment when it is assumed that all it has done has been to provide for the success, and aid in the triumphs, of its new rival—a few weeks, or months, or a year at the farthest, being reckoned sufficient for the transference of the business from one to the other. Gas companies are not so easily laid on the shelf. We have no instances of their having been either frightened or starved to death. If cats have nine lives, gas companies have ninety-nine. They may cause great offence to the public—so great as to be threatened with the loss of their business; and they may (most improperly) reject the only alternative by which rivalry can be prevented and confidence restored. Obstinately prolonging a contest, until it is too late to effect a reconciliation, they may refuse their assent to reasonable demands, and yet at last be compelled to yield to still harder terms; concession in that case losing the charm and gracefulness of good manners. But what of all this? Prices being adjusted, and the charges for gas, of course, alike on both sides, threats are forgotten, offences are forgiven, the old companies hold on their way, and, so far from being ruined, they are sometimes strengthened, and permanently

benefited by the ordeal. These are not matters of opinion, but a recital of actual occurrences. I shall not attempt to explain them. Let them speak for themselves. It would be interesting to follow some of these often-repeated incidents from their origin to their results. But space forbids. We should find in them many illustrative proofs that, the under current of good sense and kind feeling, which runs through all classes of society is broad and strong; and, when rightly directed, is but little affected by occasional agitations on the surface. Here, also, we have, formed to our hand, a gentle rebuke for those who are always finding fault with the world, and with everybody and everything in it, themselves only excepted. Here, too, we learn that a large margin is required to comprise all the contingencies, the uncertainties, and the disappointments, which ought to form part of the estimates of a competing gas company.

The manufacture and sale of gas by municipal bodies, local commissioners, or parochial authorities, is attracting attention in some parts of the kingdom. Manchester has often been quoted as an example of what might be done in this way; but without sufficient consideration of the circumstances which, in that particular case, have contributed to the success of the experiment. It should be remembered that there is only one Manchester in the world, and it is not probable there ever will be another. Its compactness, notwithstanding its rapid growth, the extraordinary facilities it possesses for obtaining coal of the best kind at a cheap rate, and the nature of its staple manufactures, as necessitating the use of artificial light, must all be taken into account in explaining why Manchester stands so entirely alone, as respects the prodigious quantity of gas supplied annually to its inhabitants, through comparatively so small an extent of mains. The profits realized have, consequently, been very great—in reality an indirect local tax paid by the consumers of gas for the improvement of the town. It cannot, I think, be denied that the price of gas at Manchester has always been relatively higher than it might have been, or than it would have been, under the same favourable conditions, if the trade had been open to the stimulus of private enterprise.

How far it may be either politic or profitable for local authorities not only to manufacture gas for public uses, but to become traders in the article, it is no part of my present object to inquire. A few words by way of caution and of warning is all that I attempt. Whatever is calculated to increase the comfort, to add to the conveniences, and to promote the prosperity of the community at large, ought to have, and must have, the hearty approval of every man who loves his species, and wishes well to his country. In devising the means of doing good let it, however, be remembered that a wrong course will never lead to a right end.

The instances are now exceedingly rare in which towns or districts, of sufficient magnitude to be lighted with gas, are not already supplied by local companies. The making of gas strictly and exclusively for supplying street-lamps is one part of the question; entering into competition with existing companies, by the sale of it, is another. In either case, it is not likely the Legislature will sanction that kind of competition, unless it be shown that the companies are unwilling, or incompetent, to do whatever can reasonably be required of them as respects both quantity and price. The advantages which it may be supposed will be possessed by works, conducted by a public body, must be taken subject to many limitations. If by purchasing existing works there be no competition, the risks are of another kind. Capital, and skill, and good management are required, whether the works be conducted by a company or a public body. In theory no reason can possibly be assigned why there should not be an equal amount of skill and energy, and the same care and economy, in one case as in the other. Still, in practice we look at things, and remember them, as they have been, and judge of them as they are; knowing they are not always what they ought to be. The consumers of gas will have to look about them, or they may find, when too late, that a fancied has been changed into a real monopoly; and they may have to pay more than their fair proportion for lighting the streets,* and, in addition to that, be the sole contributors to local alterations and improvements, the cost of which ought to be distributed amongst all classes of ratepayers, instead of falling exclusively on one class.

To refresh the memory, and thus revive attention, it may not be amiss to repeat the questions—Why is gas sold at so many different prices? What are the conditions which influence its price? How can it be known if it be charged at a fair price? The first two questions may be considered as only slight variations of each other. They may, therefore, be classed together; an answer to either being, in effect, an answer to both.

The price of gas is not fixed by any arbitrary rules. It is not dependent on the will of the manufacturers that prices vary in different parts of the kingdom, and that the difference is as great in towns only a small distance from each other, as in those hundreds of miles apart. There is reason in these things; in some cases, it is feared, not sufficiently understood by those entitled to its benefits; in others made more of than in reality it is worth.

Tested by the rules which are usually applied to articles in ordinary use, whether as necessaries or as luxuries, it often occasions surprise that gas should vary so much in price as to pass through almost every gradation from, say, 12s. to 4s. per thousand cubic feet. No such differences exist, nor would they be permitted to exist, in the prices of bread or meat, of beer or groceries, of calico or cloth; respect being had to the average quality of each article. That the retail prices of staple articles of food—bread and meat for example—are slow in adapting themselves to reductions in the prices of corn and cattle, but not so slow when the change is the other way, is a subject of common remark, and very often of general complaint.

These differences, which competition is not always sufficiently potent to prevent, are small in comparison with those just quoted as appertaining to gas. Some other causes must be in operation, or the effects would not be so dissimilar. The causes are numerous; not always, in an equal degree, exercising the same influence, nor are they uniform in their results in the same localities, or even in the same towns, at different times.

The quality, character, and cost of coal; the size of the town, and the habits, pursuits, and number of the inhabitants; the number and situations of street-lamps, and the quantity and price of the gas supplied to them; the extent of the mains, as compared with the quantity of gas sold, and whether there be more than one company;—these are the principal causes which determine relatively the price of gas in each town. The kinds of coal, best adapted for making gas, vary in price from 4s. 6d. to 23s. per ton; a difference, it will be perceived, much greater than in the prices of gas. Other conditions have to be here brought into the account. They have just been enumerated, and to a gasmaker they are, in their various aspects, known, pondered over, and perfectly understood. To lookers-on—those who only use gas and pay for it—the explanation is somewhat difficult. But I will try.

Two examples will be sufficient by way of illustration:—A moderately-large town and a small one. These will serve every purpose, either for contrast or comparison. Take the large town first, where there is only one company, the works of suitable dimensions, favourably situated, well conducted, and in full activity. Let it be further imagined that the town be well lighted, but that the quantity of gas required for the street-lamps does not exceed one-seventh or one-eighth part of the whole quantity made. In such circumstances there ought to be no waste of labour, no loss by the misapplication of materials. The quality and cost of coal is here of less importance than might be supposed. It holds its place, and will continue to do so, as a primary element of manufacture; but its effect upon the price of gas lies within prescribed limits. In large towns, where coal is dear, other kinds of fuel are dear also. Coke in such cases is of more value, and has a readier sale, than where coal is cheap. In the coal districts gas coke is not much in request. In some places it is unsaleable. So again, as respects the properties of coal, some kinds produce large quantities of excellent coke; others only a moderate quantity of an inferior quality; others a very small quantity, and unfit even to supply the furnaces with fuel. Still, with all these variations attendant upon the most important parts of the process of gas-making, there is, to a certain extent, a series of compensating agencies always at work, and helping to adjust these seeming contradictions. That which is advantageous in one place would be ruinous in another, if attempted in violation of the laws which thus run through all the arrangements. In one place a greater quantity of gas from an equal quantity of coal, or gas of superior quality, compensates for loss or unsaleableness of coke; in another the coke helps to make amends for the greater cost of the coal. These conditions are local. They have, through the force of circumstances, adapted themselves to their respective localities; and, for the present, we must be content to do the best we can with them. No general principle can be applied, in this part of the operations, by which the price of gas can be made to follow in any exact ratio that of coal.

Wherever one kind of coal is dear, all other kinds must be dear in about the same proportions; the chief part of the cost consisting of expenses incurred in carrying them from the pit's mouth to their destination. In the manufacture of gas an economical fuel for the furnaces is as much needed as coal for the retorts. The greater the distance from the coal-fields, the greater the necessity for using that particular kind of coal which, by the quality and quantity of coke it yields, serves for both purposes. Gas companies must look ahead, and be making preparations for coming changes. The long lines of railways are only beginning to test their capabilities in carrying coal. That they will do it, and do it cheaply, might be reckoned upon with certainty. The choicest products of some of the coal districts, never before seen, and scarcely heard of, beyond their own immediate neighbourhoods, will thus be distributed over the central and southern parts of the kingdom. At the most remote points, prices will be reduced and kept at uniform rates; and the nearer we approach the points of departure, the more regular will be the supply, and the lowness and equalization of prices, to all classes of consumers. In this way, as in many others, railways will fulfil their mission; bringing back to the community at large, in small but continuous streams, the wealth they have absorbed, and which has been contributed by a comparatively small number of its members.

* See 'Street-Lights,' JOURNAL OF GAS LIGHTING, Jan. 10, 1851; and, in a separate form (second edition), published by J. W. Parker, West Strand.

The quantity of gas supplied to street-lamps, and the price obtained for it, next require consideration. It is useless to expect to find an instance in which street-lights are profitable to a company; I mean profitable in a commercial sense. It may so happen that they may be, what we may term, remunerative, that is, unattended by actual loss. The greater the proportion of gas sold (by meter), as compared with that required, for street-lights, or other time-burners, the more advantageous is it to gas companies and their customers, and vice versâ.

Waste of every kind must be prevented. Unprofitable trading is only waste in another form. Both have to be paid for in the prices charged to private consumers; and thus many are taxed to compensate for the negligence, the ignorance, or the selfishness of a few. Let there be no more bargaining for gas for street-lights at or under cost prices; no more lighting of remote or suburban districts by mains, which earn nothing for the companies, on the same or lower terms than lamps in the midst of towns; no more supplying a few lamps in streets, adjacent to public thoroughfares, at a nominal price, or (to make things pleasant with public authorities) at no price at all, merely because the gas must pass the ends of such streets on its way to other consumers. These and many similar acts of folly and of injustice must be got rid of; and to be rid of them they must be exposed and denounced. Think of a baker or butcher dropping loaves of bread, or joints of meat, at half or one-third the usual prices at two or three houses in each of the out-of-the-way streets he traverses daily, in supplying his regular customers, just because the cart must go that way, whether it be at all times profitably employed or not! Quite as reasonable, and equally right, is it to expect a gas company to supply without profit, or at a positive loss, an article, let its cost be what it may, which has certainly cost something, and which, if wasted or misapplied, increases the price of all that remains.

The waste and loss incident to, and inseparable from, the manufacture and distribution of gas is very great—so great, under the most favourable conditions, as to constitute a specific item of expenditure in calculating actual results. Other circumstances being the same, the greater the extent of the mains, the greater the losses by leakage. Hence the meaning of the reference already made to works 'favourably situated'; implying those which distribute the greatest quantity of gas by the least quantity of mains, and, consequently, sustain the smallest amount of loss in that way. These things are so entirely technical that any further reference to them would here be out of place. It may be sufficient to say that the losses by waste and leakage, where there is the most careful management, varies from about one-fourth to one-sixth of the total quantities of gas produced.

Thus have I touched upon the conditions which principally affect the prices of gas. As I have passed along I have remarked upon some existing defects; the removal of which would impart greater symmetry, and give greater effect, to the supposed 'model' company. In all its essential characteristics such a company is a visible reality. There are many such companies, and the number is increasing. Rigorously adhering to my determination not to quote names, or refer to places, I know the practised eye needs no such directions to fix upon towns where gas is, and has long been, sold at minimum prices. Looking at what used to be done, and contrasting it with what is now doing, the wonder is that gas is so cheap—that so much, in that way, has been done in a little time.

Let it be understood that, whilst, according to locality, the groupings of coal districts, the quantities of gas required, and the many little things which help in making the totals in actual practice, there are limits to the profitable employment of capital in the manufacture of gas, I by no means believe that we have yet attained those limits. There is something still in the distance—something to hope, something to work for. Improvements have yet to be effected, and the secrets and resources of natural processes are to be further explored. There will be a more just appreciation and general employment of gas. Finding its way into private dwellings, its appropriate sphere, it will there minister to the necessities, increase the comforts, and add enchantment to the elegancies of domestic life. As its uses are extended, lower prices may reasonably be expected. No one of our home manufactures, more forcibly illustrates the principle, that increased consumption diminishes the costs of production. Nor must it be forgotten that prices ought to be, and eventually will be, lower in proportion, where one well-conducted establishment puts forth all its strength, exercises its utmost skill, and enjoys the full confidence of its supporters, without the necessity, and without the fear, of dividing the fruits of its labour with either a friendly or a hostile competitor.

Now we turn to the other example—a very small town—small it may be in reality, but covering a large space. Many such are lighted with gas; and for that purpose there has been laid as great an extent (length) of main for supplying 200 or 300 burners, as in a large town is sufficient for five or ten times either of those numbers. As respects coal and coke, the price of the former is generally greater than in large towns, but the value of the latter is also greater, in about the same proportion. In this case, however, the compensating agencies are ineffective. The works have not full occupation during the summer months; and that which otherwise would operate beneficially is, in the particular circumstances, injurious. The gas required for lighting streets, and the low price charged for it, is the dead-weight upon a small company. Instead of one-seventh or one-eighth of the total quantity made being used for this purpose, one-third or a half is nearer the mark. The greater the extent of the mains, in comparison with the quantity of gas passed through them, the greater the ratio of loss by waste and leakage. Here, then, we must remember that, at least, a fourth part of all the gas made goes waste; to enable the company to supply the other three-fourths to their customers. From the latter quantity deduct a third, and, in some cases, half, as the quantity supplied to street-lamps—almost always without profit, and sometimes at an actual loss—and it will be seen how small is the quantity which remains by its profitable sale to reimburse the proprietary.

Some other difficulties have to be mentioned. The town being small, the works are small in proportion. The difference, however, is so considerable, between the quantity of gas required in winter and in summer, that the operations are not conducted with the greatest advantage. This is occasioned by the street-lights being dispensed with, as is the case in many small towns, during the summer months. Waste of labour (wages) and the misapplication of coke (fuel) and other materials are unavoidable. During the winter months two or three men are employed; in summer there is not half work enough for one man. Small as the works may be, they are, in summer, not small enough. Not merely are a small retort and a small furnace required, but a fourth-part of a retort and of a furnace, and the same proportion of a man, if it could be had, would do all that was needed. It is impossible to practise the same sort of economy, and to realize the same results, in small gas stations as in large ones. In the busiest season there is an excess of labour, measured by large operations; in the slack time, three or four times more is paid for than the circumstances actually demand. But there is no help for it. The process being a continuous one, it must be watched by night as well as by day; although there may not be three hours of real work to be done during both periods.

In the circumstances thus described, how is it possible that gas can be made, and sold, as cheaply in small towns as in large ones? Half the gas made is as good as given away. The other half is charged at a proportionately higher price, to make up an average rate of profit upon the whole.

But we must look about the town in the evening. Everything seems to be conducted in a remarkably quiet way. Shop fronts of plate glass, brilliantly lighted up by ten or fifteen gas-burners, are nowhere to be found. There may be a little struggling amongst teas, sugars, and drapery goods; but the tradesmen have never thought of rivalry in lighting their shops. There may be a fair sprinkling of burners; but the gas seems afraid to come out of them in earnest. A really good light is a rare phenomenon. Look at the private residences. They have anything but a cheerful appearance; the window-blinds plainly declaring that candles are in the ascendant.

Is this anything more than might be expected? Would it not be a little out of the ordinary course of things if it were otherwise? Think of a town in which all the gas consumed in a week, is not equal to half an hour's supply in another only five or ten miles distant, and how can it be supposed that in the small town the price can be as low as in the large one? But even this case has its limit; and where all is done that might be, and ought to be, done, the difference in prices need not be so great as to leave any cause for complaint. Making large allowances for objections which it is difficult to answer, for prejudices which time and experience alone will subdue, for discouragements in quarters where they were least expected, and for the half-heartedness of those who, by their example and influence, ought to have helped forward the little gas company, I still believe that, even in very small towns, more might be done than has been either contemplated, or accomplished. Those who have the most cause to complain of the high price of gas, are exactly the persons who have the power of relieving themselves of the burden. They should set about it in two ways—first, by compelling parochial authorities to pay a fair price for the gas used in lighting streets; and next, by lighting their own private dwellings, and advising their neighbours and friends to follow their example. Where everything is at a standstill, there is not much encouragement for a gas company to make the first move, which is looked upon as adverse to their own interests. Where there is cause for complaint, let it be boldly and courteously stated. Talk *to* gas companies, not *at* them. Do the same with respect to guardians, inspectors, or local commissioners; recollecting that, in these matters, the right way is the shortest, the safest, and the best. Settle the street-light business first. Put that on its right basis, and a reduction in the price will immediately follow; to be succeeded by others as the supply to private consumers increases. These are the natural and uniform results; a reduction in price always being accompanied by increased consumption; those who now use gas using more, and those who had not before began being encouraged to do so.* Great differences

* Whilst writing this, a gentleman has called who states as follows:—'I took the advice you gave me last year. On returning home a meeting of the directors was summoned, and we decided on reducing the price of gas from 10s. to 8s. per 1000. Our customers have since very much increased. We are doing better than ever.' The population of the town is about 6000.

exist in the habits and occupations of communities, as well as of persons. A growing, thriving, bustling population will, in everything, leave behind them their near neighbours, who are content with things as they are. It is useless to attempt to help those who make no efforts to help themselves.

How can it it be known if gas be charged at a fair price?

Not by examining the half-yearly accounts of gas companies. Not by plodding over share-lists to ascertain the amount of their capital, the value of their shares, and the rate of dividends. Not by complaining every three months, when the bills for gas are paid, that the charge is too high. Not by sending into Yorkshire, or Lancashire, or Staffordshire, to inquire the price of gas, for the purpose of comparison with towns, of about an equal number of inhabitants, in Kent, Sussex, or Berkshire. Not by causing paragraphs to be inserted in newspapers, often beginning with misrepresentations, and ending with falsehoods. Not by quoting, as applicable to any town in the kingdom, the (so-called) cost of gas produced in prisons, factories, and other large establishments, where no notice is taken of the cost of works, keeping them in condition, and the labour employed in conducting the operations.

Let it not be said that I am averse to inquiry and discussion. Just the contrary. In many instances these have been mainly instrumental in teaching gas companies their duties, and in stimulating them to look to their true interests. All that I desire is that such inquiries, and the discussions arising out of them, should be conducted temperately, courteously, wisely; with good-will and good-humour on both sides. If on either side these rules are violated, the offending party deserves to suffer.

It matters but little whether gas companies, or the consumers of gas, institute inquiries as to the prices charged in particular localities. The process should be the same in both cases, or the results will not agree. In practice this is commonly the most difficult point to settle. Gas companies, of course, have the advantage of experience in dealing with the statistics of their own business. There is also the leaning of self-interest, and, not unfrequently, too much timidity. On the other side, a mass of information is collected, but for want of a settled plan, and the requisite amount of knowledge to arrange and analyze it, the possessors know not how to turn it to account.

A few suggestions will probably help to solve some of these difficulties.

Here we must try to recollect some of the things mentioned before, such as the character and cost of coal, the value of coke, the quantity of gas annually produced, the number of street-lamps, the quantity of gas supplied to them, and the price paid, not per lamp, including other charges, but per 1000 cubic feet. The greater the quantity sold to public authorities, and the lower the price, the greater in certain proportions will be, and ought to be, the price charged to private consumers. We must not forget the groupings of the coal districts; the limits of which are easily known. If we pass over these boundaries, we may place different towns in contrast with each other; but we do not fairly compare them. Population is not a very exact indication of the quantity of gas sold in a town. It is governed by the station in life, the pursuits, and the tastes of the inhabitants. This will occasion no practical difficulty. There are plenty of instances, and some of all sorts—towns larger and smaller, as well as those which seem exactly to match—will be the more instructive. Still remembering to keep to the proper coal districts, look round and select the towns, in which gas is sold at the lowest prices. Where differences exist, not at once apparent, try if they can be accounted for satisfactorily. In doing this there must be something more than merely looking at the surface. Local duties, or usages, and other, apparently little, things, will have to be considered. In general, gas operations will be found to be in the most healthful condition, where there is no competition. I stop not here to reason upon this: it is enough to state the fact. It matters not how often there may have been threats of competition. Where companies have been wise in time, they have disarmed hostility, and have done two things well, whilst they appeared to be directing their energies to only one—that is, the public have been well served, and their own interests promoted. In the metropolis gas-lighting possesses so few points in common, with the operations in the provinces, that no comparisons can be fairly instituted between them.

Supposing that in the town where complaints are made, and towards which the inquiries just enumerated have been directed, it should be found that the price of gas is already as low as in any town, of about the same size, within the assigned district, what, in that case, is to be done? All other circumstances being favourable, the gas company should not rest too much upon the past, nor be content with the present, but expect something from the future. What is the condition, and what are the prospects, of the town? The answers to these questions should be well considered. If old shops are being changed into new ones, and new ones are rising up where none before existed; if buildings, completed, and in progress, cover the outskirts of the town, some for business purposes, and some for private residences, it is certain more gas will soon be required. No method is so effective in hastening its adoption as a low price. Here, then, is an occasion which ought to be turned to account, and in which a gas company need not be ashamed nor afraid to set an example of a lower price. By this time companies ought to know that, in such matters, confidence in the public, and in the capabilities of gas-lighting, have never been misplaced.

In all these supposed arrangements nothing has been said about the profits, or, in other words, the dividends receivable by the companies. Dividend or no dividend is not a part of the present inquiry. The price of gas is what we have to deal with. Keep the two things apart. Let each take care of itself. In discussing the prices of gas, when the companies begin to talk to the public about their dividends, it is a sure sign they have used up all their best arguments.

The public are entitled, according to locality, size, and capabilities of the town, and other conditions to be measured and adjusted by the rules just indicated, to be supplied with good and pure gas, at its lowest commercial value. This implies that the works should be of such a size and value as shall be best adapted to the wants of the town; combining recent improvements in the manufacturing, and other, processes, with efficient and economical management. It also implies that companies are entitled to a fair rate of profit on the capital thus invested. Measured by the profits usually made in trade and manufactures, the history of many gas companies testify that they have not had a thriving business. Whatever be the amount of profits, they must in reality consist of the difference between the cost, and the selling, prices of gas. The means of ascertaining the first of these is, evidently, a favourite puzzle with many clever people; and, although they make extraordinary blunders, they, nevertheless, declare that nothing is easier. I neither attempt nor presume to enlighten them. Some things in gas-lighting are plain enough to ordinary observers; others are not quite so plain as might be expected to the practised eye, even when aided by an intelligent and experienced mind. A practical gas-man knows, and often feels, more sensitively, perhaps, than his neighbours, that it is easier to ask questions than to answer them. I think I have said enough to show that no general, or arbitrary, rules can fix the price of gas, irrespectively of the coal districts, and other local and special circumstances. The cost prices are even more variable than the selling prices. To those who so positively assert that the profits made by gas companies must be greater than they are admitted to be, let me hint that it would be kind of them to try and find out, and inform the proprietors, what becomes of the money. The mere pleasure of serving the public is not the motive to action in managing such matters. The hope and expectation of gain keep hands, and heads, and minds at work. These are not times in which workers, or watchers—those in active service, or those who are looking at the results—can afford, or have any inclination, to be either negligent or wasteful.

Black Rock, Brighton, March, 1851.

GAS LIGHTING IN GERMANY.

HAMBURG.

Continued from page 25.)

Art. 19. The payment by the State for the public lights, as well for the streets as for all public buildings, shall be made quarterly on the last day of March, June, September, and November. Till the whole of the gas lighting is in operation, the payments must be made at these quarterly periods.

Art. 20. If the public lighting shall be delayed beyond the time appointed, by the default of the arrangements, or that of any of the company, or of the persons or servants appointed by them, or by any obstructing circumstance, such as the freezing of a pipe, shall be considered to be either collectively, or in single streets, or in single lamps; or if particular lamps will not burn, or go out too soon, a fine of 4 sch. Hamburg currency per lamp shall be imposed and paid.

Should the lighting, for like reasons, not take place at all, or not in particular streets, the penalty, besides payment being withheld, shall be 12 sch. Hamburg currency (10.68d.) per lamp.

Such contravention shall be proved by the testimony of the sworn officers appointed by the Exchequer authorities, or the testimony of the watchmen; communication of the same shall be made to the agent of the company, whereon he must make his statement within twice twenty-four hours. In regard to the testimony of watchmen, the agent may demand a police examination; the cost of which, in case of a decision against him, must be borne by him.

Art. 21. Should the gas lighting be interrupted generally, be it by the fault of the company or not, or by any other cause, the company must provide the most speedy removal of this hinderance, and provisionally by some other public lighting at their own cost.

To be the better provided with such temporary resource, the company must preserve and keep in good order, in a place distant from the gas works, the lamps and lamp reflectors of the oil lamps till then in use, to be charged at a valuation, and credited by them. The Exchequer authorities will, in such case, allow any stock of the lamps then in use, which are to be placed on temporary posts by the company.

If the temporary interruption of the gas lighting has taken place without the fault of the company, the payment for the street lighting shall remain unaltered during the temporary oil lighting.

Art. 22. The company must regularly be provided with an ample stock of coals, that is to say, they are bound at the end of the

autumn to have such a stock as will last them till the month of May of the following year.

Should, however, the supply by sea be impeded by war or blockade for a long time, both contracting parties may agree as to the substitute of coals to be obtained from the Continent, or some other material, for gas lighting; and the prices of public and private lighting, in the same proportion as they are now fixed, shall be regulated by the difference which may be shown to exist between the cost of preparing and providing gas from this material, to that till then made from the British coal.

If the company must raise the price compared with the former ones, this increase shall only take place so far as two-thirds of the net profits of the preceding year, of which the most accurate vouchers shall be produced, and in which interest on the cost of the works and working capital is not charged.

Art. 23. The company is bound to remove, with all speed, any grievances which may arise in particular cases, be it in respect of public or private lighting. But should it, contrary to expectation, appear that such evils are caused by defectiveness, and in faults in the principal works generally, be it in the gas works or in the system of pipes, or otherwise, the company is bound to make good these faults and defectiveness by such works as are adapted to and render them fully sufficient under the circumstances, and under all the eventualities, within a period to be fixed by persons skilled in the matter, and at their own costs.

Should the company not correct these well-founded complaints, arising from the faults and defects of the works, in sufficient time, the Exchequer authorities have the right to interfere, and to direct such faults and defects to be made good for the account of the company. Should the company then refuse to repay the costs arising thereby, or be unable to repay the same, then the State stands in their stead; and the condition in Art. 35, stipulating the handing over of possession of the works, with all thereto belonging, to the State, takes place without further indemnification, as this condition is put in in order to provide against defective works.

This clause shall be considered and interpreted in every respect as a *bonâ fide* clause.

Art. 24. The Exchequer authorities declare themselves willing to continue the lighting with oil, where gas lighting is not substituted, in the city suburbs, and wherever it is now done, during three years from the date hereof; but retain the right, after the expiration of these three years, to transfer the public oil lighting, then in operation, to the company, against a payment of 22 marks and 4 schillings Hamburg currency yearly, for every globular lamp burning three-quarters of an half ounce of oil per hour.

Art. 25. The whole of the officers and persons now employed in lighting, except they refuse, and except the Exchequer authorities retain them as comptrollers, pass into the service of the company; and the same promise sincerely to make it a point to employ them according to their utility, and in a capacity suitable to their ability, and not with less wages.

Any dismissal of the persons who are referred to in this contract is to be judged of according to the contents of the contract. The same can only be dismissed on account of incapacity for their new employment, and after consultation with the Exchequer authorities, and agreement with them. The other servants can only be dismissed on account of repeated and outrageous abuse of their service, and decided unfitness.

This change shall only take place successively in so far as the gas lighting supersedes the present lighting, and the employed therein can be dispensed with.

From the date hereof, provisional appointments shall only be made under the present system of lighting.

The lamplighters and other persons, or workmen, employed in the gas lighting, cannot ask Christmas-boxes, New Year's-gifts, or such-like contributions.

Art 26. The Exchequer authorities consent that the building which Messrs. Gleichman and Busse have erected, and which was let to them till the festival of St. John the Baptist, 1868, situated on the Grasbrook, and assigned to the Gas Company in the Land Register (Landbuch), and also the premises on the Grasbrook, near the Elbe, let to the said Messrs. Gleichman and Busse, subject to a half-yearly notice to quit, shall be assigned to the said company in the Exchequer Contract-book (Kammerie Contracten-buche); the existing contract with the Exchequer shall be annulled, and a new Exchequer contract shall be entered into with the present Gas Company, as to all the premises, inclusive of the enlargement of the last-mentioned premises, for thirty years, from the 1st of April of the present year, till the last day of March, 1874, and the building shall be registered in the Landbuch for the duration of the contract to them, in consideration whereof they agree to pay the yearly sum of 1600 marks Hamburg currency, and to ensure the same therein as the first encumbrance, and to allow the application of the clause in Art. 36, sub. 3.

Art. 27. The site of the gas works is to be secured by the company, at their own cost, against high tides, in such manner that in high tides no interruption is to be feared as to the supply of gas. The rule in Art. 5 is applicable, as to future increased requirements, so that the building and the whole of the establishment of the gas works, as also the whole of the apparatus, engines, and fixtures, shall be constructed and made in the best substantial and most complete manner.

The company expressly declares its intention in this respect, and will be bound by it to employ the most lasting, useful, and complete materials.

The company have to give exact and ample information in the inquiry, and to complete the information as to the mode and manner of fitting up their gas works, in compliance with the stipulation of Art. 29.

The company are reminded that, by the harbour and other works, many essential alterations in the site of the Grasbrook are at hand, and that till the same are completed they can only proceed with a temporary laying of the pipes.

Art. 28. The Exchequer authorities declare their readiness to indicate ground belonging to the state (in case there should be any suitable and applicable), for any required reserve gasometer, at a reasonable rent. Should such state property, suitable and applicable, not be found, the company will exert themselves to acquire the property in ground that is applicable; and in every case, should the renting of such property be unavoidable, after consulting with the Exchequer authorities, they shall take care that, at the expiration of the contract, the holding of the place at a fixed rent should not terminate.

Art. 29. The Exchequer authorities reserve to themselves the right not only to examine the plan for the gas works in all its details before its coming into operation (with the exception of the details kept secret according to Art. 13), but also to appoint one or more official personages to inspect and watch over the engagements entered into by the company by contract, and for obtaining the conviction that the works are executed of the proposed efficiency and completeness. To these officers access is allowed to all works at all times during and after their execution.

At the expiration of the first year the company has to produce an exact sketch of their works, executed in duplicate, and to complete the same yearly.

Art. 30. All differences which may arise as to the execution of this contract, or as to the meaning of its conditions; and as to the satisfactory attention and sufficient fulfilment of the stipulated production and purifying of the gas, or as to the introduction of the improvements mentioned in Art. 13, or by later invention, in the production and purifying of the gas; or also in regard to the relations established by this control; as also as to the conditions respecting fines or damages which may accrue in accordance with the present contract, be they fixed in maximum or not, shall, as a rule (and, if the contracting parties shall not in particular cases agree as to a larger number), be decided and determined upon by three persons skilled in the matter, or liegemen, each party may choose one of such persons skilled in the matters, or liegemen, and these two conjointly a third; and on the said two persons learned in the matter, or liegemen, not agreeing as to the third person, the Court of Commerce shall be applied to, to appoint the same, whose decision shall be effectual. The nomination on both sides must take place within three days after being required; but, in the contrary case, the Court of Commerce shall undertake the same, unless a longer time is agreed upon.

When the contracting parties cannot agree as to an exception, the persons skilled in the matter, or liegemen, shall be such as are in the Hamburg Nexu, or, by virtue of their office, belong to the State of Hamburg.

No legal proceedings against such a decision of arbitration can be taken, and the execution of the same belongs to the Pratur, and in the second instance, where the same can interfere, to the Supreme Court.

Notwithstanding the regulation that a decision of arbitrators shall be taken in general, yet the Exchequer authorities are at liberty, in cases which they may see fit, to have recourse to the judicial decision of the Court of Commerce. The Superior Court cannot, as second instance, be denied in either cases.

Art. 31. All penalties fixed by this contract, or declared by the arbitrators or judicial decisions, shall fall to the Exchequer, and the Exchequer authorities are empowered to deduct the same from the payments to be made for the public lights.

Art. 32. The Gas Company will be represented, in regard to the State and to private individuals, in all and every respect, by their authorized agent, Mr. James Godfrey Booth; every change of the person of the authorized agent of the company is to be notified to the Exchequer authorities, and the appointment must always be legally obligatory on the company and their lawful successors.

The deed of copartnership of the company shall be deposited in the Office of Firms, and a copy of the same be furnished to the Exchequer authorities.

Art. 33. No contract with private individuals can be concluded for longer than the duration of this contract, without the concurrence of the Exchequr authorities, nor can the determining power in regard to private individuals be encumbered with a longer period than half a year.

The conditions of the company must be in accordance with the stipulations contained in this contract as to the supply of gas to private persons. The form of these conditions is to be laid before the Senate for approval.

The apparatus for measuring and controlling the gas supplied

to private persons shall be under the care of the authorities and officers appointed for weights and measures.

Detached branch pipes for the supply of private persons, with the exception of the present Grasbrook, may not be laid out from the gas works.

Art 34. The company is assured that, during the continuance of this contract, to no other person shall be granted the power to sell gas to the State or private persons, by means of pipes along the streets and public places; as to the supply of gas otherwise, this privilege does not extend. The lighting of the streets and public places shall, however, during the duration of the contract, only be effected by means of gas pipes.

Art. 35. At the expiration of the contract, the whole of the works, with all the buildings, gas works, objects, pipes, fixtures, and all and every other appurtenance, as also any existing reserve gasometer, as unencumbered property, shall, *without any further consideration*, pass over to the State in a perfect and complete condition, as well as the lamps and lamp reflectors used in the previous oil lighting (Art. 21), which are to be returned, or to be replaced according to valuation.

For any extension of the pipes, however, which may be required by the Exchequer authorities within the last ten years of the contract, *two-thirds*, and should it be required within the last three years of the time of the contract, *the whole*, ascertained cost of extending the works shall be repaid at the expiration of the contract.

The Exchequer authorities do not bind themselves to retain those persons who may be in the employ of the Gas Company at the expiration of the contract.

The then existing stock of coals and other materials used for the production of gas is to be delivered and accepted by the respective parties at a valuation.

Art. 36. As security for the fulfiment of the stipulations of this contract are available for the State,—

1. A deposit of 80,000 marks banco, which, that it may bear interest for the depositors, must be invested in the Hamburg public securities, and can only be demanded back after the time of the delivery of possession of the works, with their appurtenances, to the State.

2. The personal guarantee of the whole of the proprietors, each for the amount of the sum signed for by him, and the obligation under the hand of these proprietors, and annexed at signing of the contract. With the completion of the works this guarantee ceases.

3. The works themselves, with the buildings, pipes, reserve gasometer, fixtures, and stock, and all and every appurtenance. For this purpose, any encumbrance of the land or lands on the Grasbrook must be discharged within six months, and to the register of the ground in the Land-mortgage Book (Land-hypotheken Buch), as also in the Exchequer Contract Book (Kammerei Contracten Buch), the following clause added:—

"Be it known that this piece of ground, with all buildings standing or hereafter to be erected thereon, and the service pipes and other works, can only be used as gas works, and for the operations necessary in connection with the same; the same further, with all appurtenances, serve as collateral security for the fulfilment of a contract entered into the 28th of March, 1844, for the lighting of the city and suburbs by means of pipe gas; and at the expiration of the contract, also on the last day of March, 1874, shall go as full and free property, with all appertaining to the works, to the State of Hamburg."

And accordingly the same can neither be assigned, nor encumbered, nor clogged with any other condition.

The commencement of the career of the company formed for carrying the above-recited contract into operation was beset with difficulties, which at one period threatened it with a disastrous failure. The process mentioned in Article 13, by which the gas to be made should "not only far exceed the gas produced from Newcastle coal, but shall also be free from sulphurous and water contents, as also the smell from burning of the soot and vapour in confined places, and every danger of the freezing in the pipes," a description of which process, after undergoing the ordeal of an approval by Professor Wiebel, was mysteriously sealed up, and annexed to the contract, turned out to be a miserable imposture, and completely failed in answering the promised ends. But a more serious difficulty still had to be contended with, from which the company has scarcely yet recovered. The site selected for the erection of the works was one of the many small islands in the Elbe, opposite to the city, the soil of which was, to an unknown depth, the alluvial deposit of the river, and, consequently, totally unfit for sustaining the heavy buildings and machinery of a gas work, without extraordinary precautions in the construction of solid foundations. Such precautions were unfortunately neglected, and the result was, an early suspension of the lighting, the tanks having got out of level to such an extent as to prevent the gasholders rising vertically, and other accidents, caused by similar defects in the foundations. The experience of William Lindley, Esq., C.E., who had so highly distinguished himself in supplying Hamburg with water, in draining its once filthy streets, and in promoting its general salubrity, was, in 1846, solicited to aid in the reorganization of the establishment; and, under his direction, new buildings have been solidly constructed in a style which has excited general admiration. In the rearrangement of the apparatus he has been most ably seconded by Mr. B. W. Thurston, the present acting engineer and manager of the works. They now consist of two retort-houses, each containing 150 retorts, with appropriate condensing and purifying apparatus, sufficient for 40,000 cubic feet of gas per hour; coal-stores, containing 10,000 tons of coals, four gasholders, of 80 feet in diameter, and 26 feet deep, with two 18-in. mains into the city. There are also extensive smiths' and fitting shops, and a manufactory for the conversion of the ammoniacal liquor into sal-ammoniac.

We have been favoured with copies of the balance-sheets of the fifth and sixth years of the company's operations; and, considering the difficulties and prejudices which have had to be encountered, they afford much encouragement for the hope that its shareholders may yet receive a fair return upon the capital invested. The price of gas to private consumers, of 6 marks per 1000 Hamburg feet, is equal to 8s. 8d. per 1000 feet English, and when it is borne in mind that while coals are nearly as cheap in Hamburg as in London, and labour considerably cheaper, it is evident that an unexpired monopoly of twenty-four years contains sufficient elements for the repayment of the original capital, in addition to a fair dividend.

Account of the Receipts and Expenditure of the Hamburg Gas Company for the year ending March 31, 1849.

Dr.	£	s.	d.	*Cr.*	£	s.	d.
To expenses of manufacturing 75,491,745* Hamburg cubic feet of gas (62,643,050 cubic feet English, against 60,329,265 cubic feet English made in the previous year)	10,909	8	2	By balance from previous account	2,002	11	8
To allowance to managing director	200	5	1	By sale of gas from April 1, 1848, to March 31, 1849:—			
To allowance to directors	32	15	7	Private lights £13,836 5 8			
To repairs of premises, salaries, taxes, insurance, expenses on loan, and incidentals	963	7	9	Public buildings 490 8 4			
To office expenses	334	15	1	Public lights 5,584 1 8			
To bad debts	146	6	3	Private street lights 33 7 4			
To interest and commission on loan	31	16	7		19,944	3	0
To reserve, according to Art. 9 of the Statutes	67	2	6	By interest on deposit with the corporation	208	19	1
	£12,685	17	0	By rent	109	10	7
Profit to be divided on the paid-up capital of £141,026	9,866	17	6	By balance of gas-fitting account	287	10	2
	£22,552	14	6		£22,552	14	6

Account of the Receipts and Expenditure of the Hamburg Gas Company for the year ending March 31, 1850.

Dr.	£	s.	d.	*Cr.*	£	s.	d.
To expenses of manufacturing 97,517,057 Hamburg cubic feet of gas (80,919,653 feet English, against 62,643,050 feet in the previous year)	14,082	12	11	By balance from previous account	67	2	6
To repairs of premises, salaries, taxes, insurance, and incidentals	710	5	11	By sales of gas from April 1, 1849, to March 31, 1850:—			
To interest on loan	662	5	4	Private lights £17,199 12 10			
To office expenses	569	17	0	Public buildings 725 1 2			
To bad debts	31	16	11	Public lights 7,500 8 0			
To reserve fund, according to Art. 9 of the Statutes	468	7	11	Private street lights 29 4 5			
	£16,525	6	0		£25,454	6	5
Profit to be divided on the paid-up capital of £150,671	9,047	15	5	By rent	9	8	1
				By sundries	42	4	5
	£25,573	1	5		£25,573	1	5

* The quantities of gas given in these accounts would appear to be the net quantity sold.

GAS WORKS AT THE WAKEFIELD HOUSE OF CORRECTION.

The observations made under this head in the last number of this Journal have been construed by the *Artizan* into "a gentle castigation, because it had the audacity to question the propriety of charging a monopoly price for gas." This is so palpable an attempt to shift the ground upon which our "gentle castigation" was founded, that we are induced to return to the subject, principally for the purpose of setting our contemporary right upon it. Our attention had been drawn to the article in the January number of the *Artizan* by repeated advertisements in most of the daily papers, so worded that the public were led to believe it contained the revelation of some secret by which they were to obtain a supply of gas at NINEPENCE PER 1000 FEET. Such a prostitution of the letter and spirit of the article in question was too apparent to escape the observation of any one having even a slight acquaintance with the subject; and our remarks were directed more to prevent the repetition of such misrepresentations than to pick any quarrel with the data it afforded; and, if we succeeded in effecting this, our end is accomplished.

We are ignorant of the circumstances under which these gas works were erected, or what is considered a monopoly price in Wakefield. We see by Mr. Hume's return that the present average price charged by the gas company is 4s. per 1000 feet, and we have always been advocates of a graduated scale according to consumption, so arranged that the large consumers of gas may obtain their supply from the public establishment at a cheaper rate than they can manufacture it for themselves. The data given by our contemporary are evidence that gas cannot be manufactured on a small scale so economically as on a large one, and this very difference in cost is considered as a sufficient profit by most gas companies.

Our contemporary concludes by asking us two questions: first, "Are gas works in general worked by convicts?" and, secondly, "Is there any difference in the per centage of fuel required for carbonization when 9 retorts only are used, or when there are 500 set in one house?" questions which we have no hesitation in replying to.

Convict labour may, we apprehend, be quite as beneficially applied to the charging and discharging of a gas retort, as in treading on the wheel, or picking oakum, if not more so; and who knows but that a fourteen or twenty-one days' residence in the Wakefield House of Correction may perfect the education of many a stoker, and fit him to take the lead in a snug little Yorkshire gas work; for, in truth, within our own experience we have often seen farm labourers, fresh from the plough-tail, under intelligent tuition, become as able stokers as the man who has "served his time" (not under restraint) to a full apprenticeship. On principle, therefore, we entirely approve of the application of the labour of the inmates of prisons, lunatic asylums, and similar establishments to such purposes as the making of gas, though we doubt whether any economy will result by its adoption, from the small scale upon which such manufactories are organized and carried on..

To the second question we might with perfect truth answer that the per centage of fuel for carbonization *ought not* to be any greater where 9 retorts only are used, than where 500 are used, but we have no intention of availing ourselves of any *lapsus* in the mode of putting the question. Retorts may be so set as to work economically in beds of either 5, 6, 7, or 9 retorts, and upwards; and it matters little, so far as the fuel is concerned, which of these numbers per bed may be adopted for a work complete in itself, or as part of a large system. Where a less number than 5 retorts are set together, then the per centage of fuel will increase to some extent, but under no circumstances, where ordinary skill is exercised in a gas work of similar extent, should it exceed one half of that stated to have been required at the model gas works of the Wakefield House of Correction. Is the *Artizan* content with our candour?

Miscellaneous News.

FATAL EXPLOSION AT MR. STEPHEN WHITE'S NAPHTHA DISTILLERY.

An explosion, attended with loss of two lives, took place on the 14th ult. upon some premises occupied as a naphtha distillery, in Springfield-lane, Salford. It seems that Mr. Stephen White determined to distil the residuum from the manufacture of his hydro-carbon gas himself, and for this purpose he hired an empty yard in a small street off Springfield-lane, Salford, where preparations were made for carryiug on the manufacture of the articles mentioned above, under the direction of our intelligent correspondent, Mr. Joseph Wainwright Hodgetts, who had been appointed manager. The yard is about ninety feet square, and contained at the south-western end a wooden shed, covered with slates, under which were placed two stills with the furnace necessary for heating them, and three tubs filled with cold water, with cooling worms in them, which were connected with the stills by means of copper pipes, and from which the fluid, after passing through the worms, ran by means of other pipes into a cistern in the centre of the yard. At the other side of the yard was a large tank which contained, at the time of the accident, about 400 gallons of the material to be used in the distillery.

The works were only got into operation on Monday, the 10th of February, and everything was going on well for the first two days. When, however, a man named William Collier, who was employed upon the premises, went to work on the morning of the 14th, he found that there was an escape of steam from the joint between the upper and lower parts of the still. This escape continuing to increase, he became alarmed, and, after raking out the fire, went to fetch Mr. Hodgetts. As soon as that gentleman arrived, at about a quarter past nine o'clock, he examined the state of the still and the cooling-tub, and, conceiving that something must have got fast in the worm, opened the tap of the cooling-tub which was in use, and let off the water, in order that the heat from the still might melt whatever it was that stopped the passage of the worm. After doing this he got up upon the top of the tub, in order to watch what was going on. By some agency or other, which is not satisfactorily explained, the contents of the still became ignited, filling the whole place with flames, and causing a succession of three explosions. Mr. Hodgetts was at once surrounded with fire, and was heard by one of the men, while effecting his own escape, to call loudly for help. A man named Francis Gallaghan, who was at work in the adjoining premises, occupied by Mr. M'Guire, upon hearing the noise caused by the explosion of the naphtha, and seeing the flames, ran into the yard, and saw Mr. Hodgetts emerge from the flames with his clothes on fire, and fall down in a shed. This man stripped off Mr. Hodgetts' clothes, and threw over him first a sack and then some water, by means of which he extinguished the flames which were about him, when it was found that he wes quite dead, and his body was at once removed to the William the Fourth Inn, in Springfield-lane. At the time the ignition of the fluid took place, a man named Lowe was standing upon a ladder near to the cooling-tub, and was severely burned about the head and upper part of the body by the flames. He walked to the Royal Dispensary, Salford, and was conveyed thence in a cab to the Royal Infirmary, where he expired on the following day. Besides this man and Mr. Hodgetts, there were upon the premises the man Collier, who had fetched that gentleman, and a joiner named Cliffe. The former being in the privy at the time escaped unhurt, but the latter was much burned. The shed being enveloped in flames, information was sent to the Salford Police-office. The chief constable, Mr. Neale, immediately proceeded thither with a body of firemen, and the fire-engine Nile, which was quickly followed by the Deluge. These engines were at once got to work, and were assisted by one belonging to Mr. Dearman. Great fears were entertained that the flames from the receiving-tub in the centre of the yard, which ascended a great height into the air, would extend to the tank at the end of the yard, containing 400 gallons of resin oil, when the destruction of a large portion of the surrounding property would have been inevitable; and, as water appeared only to increase the violence of the flames, a large quantity of bricks and dry rubbish was, under the direction of Mr. Neale, thrown into this cistern, which speedily extinguished the flames, and left nothing to fear on that score. The engines, which were well supplied with water, continued to play, and the fire was subdued in about half an hour. Much apprehension was entertained before the fire was extinguished that further explosions might take place, but, fortunately, such was not the case. The amount of property destroyed by the fire is but trifling; and, were it not for the loss of life occasioned by it, the accident would not be of a serious nature. Some idea may be formed of the intense heat of the blazing liquid with which Mr. Hodgetts was surrounded from the circumstance that the watch in his pocket, and the glasses of a double eyeglass which was round his neck, were completely melted. Mr. Hodgetts' body was frightfully burned all over, the face being almost reduced to a cinder; and the only part which has escaped the flames being a small portion of the scalp.

Mr. J. W. Hodgetts, who has thus lamentably perished, was favourably known as the editor of an excellent work on chemistry, written by his father-in-law, "Parkes's Chemical Dictionary," and by several interesting contributions to this journal. He, many years ago, was manager of the Salford Gas Works, and subsequently established some chemical works in the neighbourhood of Manchester, but, these not proving so successful as he had anticipated, he left, and for some years resided in a different part of the kingdom. He returned to Manchester only a few months since, and was for some time engaged, on behalf of Mr. White, in conducting at one of the stations of the Manchester Gas Works some comparative experiments as to the cost and illuminating power of gas produced from coal tar. We believe he had some intention of proceeding to Rio Janeiro in the course of a short time, to act there as manager for lighting that city with gas. In the meantime he commenced the manufacture which has prematurely destroyed him. He was well known in the scientific world both as a practical chemist and an experimental philosopher. The distraction of Mrs. Hodgetts (a daughter of Mr. Parkes, the celebrated chemist) on learning the sudden and dreadful bereavement which she has suffered may be imagined. She refused for some time to be removed from the room in which the mangled remains of her husband were deposited, and is now in a state of great mental and bodily suffering, the result of the terrible shock. Mr. Hodgetts, who was upwards of fifty, has also left a son and a daughter.

THE INQUEST ON MR. HODGETTS

was held at the William IV. Inn, Springfield-lane, the same afternoon, before Mr. W. S. Rutter, the county coroner, when, after the jury had viewed the body and the premises, the following evidence was adduced:—

WILLIAM COLLIER, a labourer, residing at Green Vale-court, Bridgewater-street, stated: I was employed at Mr. Hodgetts' works in Phillip-street. He used those works for the manufacture of naphtha. He commenced on Monday last. The still that has been worked was the one nearest the door. One charge was worked out of it during Monday and Tuesday, and it was again charged yesterday afternoon. It was charged with resin oil. From this still the vapour was conveyed through a large tube to a lead worm, which is placed in a tub full of cold water, and on coming from that tub in a

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state resembling water, mixed with a little oil, it was received into another tub which is open, and was only put down yesterday. This is only the first process, but I do not know what had to be done next, as we had gone no further. Part of the product of the first charge had been removed and put into carboys. Mr. Hodgetts was present, and directed me when I put the second charge into the still yesterday afternoon. The lid of the still is fastened on by means of a number of screws. William Cliffe fastened on the lid yesterday afternoon. He is now at the infirmary. Mr. Hodgetts was then in the yard, but took no part in putting on the lid. The fire was lighted last night in his presence. It remained in all night. Mr. Hodgetts was not on the premises later than from five to half-past yesterday afternoon. I left at six o'clock, but returned at ten to make the fire up again. I went away again in a few minutes, leaving no one there. I went again at six o'clock this morning. I was the first there. William Cliffe came next, and then Lowe, the joiner. Mr. Hodgetts came next, at nine o'clock. Nothing had happened, but I was frightened, and went for him. The condensing-pipe had stopped somewhere. I know that because there was very little condensation going on, and a great pressure of steam in the still. When Mr. Hodgetts came he examined the still and tub, and opened the tap of the condensing-tub for the cold water to run out. He said it was fast somewhere in the worm in the tub, and as the cold water got out the heat from the still would melt the substance that had got fast. He allowed it to run until the explosion took place. When that happened he was on the top of the condenser, close to the still. That was about a quarter past nine. I was in the necessary. I heard a rushing sort of a noise, and then saw William Cliffe running across the yard with his hand before him, as if he had something about him he did not like to touch. I then saw the joiner run across the yard all in a blaze, and while making my escape from the yard heard Mr. Hodgetts, in the midst of flames several yards thick, calling out as hard as he could, "O dear! help, help!" I got clear out of the yard, having passed over the ground where Mr. Hodgetts was found. I shortly afterwards returned to the yard. I helped to take up Mr. Hodgetts, whom we found under the shed, about fifteen yards from the still. He was laid with his face on the floor, and I never saw him breathe. We placed him upon a door. He was shockingly burned upon the head and body. Before I went for Mr. Hodgetts I had seen the steam forcing itself from a joint in the still end, level with the brickwork. The steam escaped all round, but at one place it came out the thickness of a finger, in a large quantity. I first perceived a slight escape at about half-past seven o'clock. It gradually increased; and, at about eight, I took out all the fire I could from under the still, and went for Mr. Hodgetts. The still had been worked before, and was bought from a place in Water-street. That was about five weeks ago. I should say it is made of iron. Some of Mr. White's men put it up. Mr. White is one of the proprietors of the place. The still appeared to be perfect when it was put up, and I never perceived any imperfection in its working before this morning. The steam did not abate after I took out the fire. The escape was as great as I have previously mentioned when Mr. Hodgetts came, and he must have seen it. Since the fire was subdued I have examined the still, and it appears to me as if the top part of the still was lifted off the bottom part, as there is now no cement between them, and I can cram my fingers down. The joint I have alluded to was a cemented one, and the cement is now all driven out. I cannot say how the fire and the naphtha got together. There was no fire but that in the stove. The force of the steam would drive out the oil. When I went into the necessary I left Cliffe on a ladder at the side of the condensing-tub, opposite to the still, and Lowe at work at his bench in the yard. Mr. Hodgetts was on the top of the condensing-tub.

Saville Swanwick Smith said: I am superintendent of Mr. White's establishment in Edmond street, William-street, Salford, for making apparatus for gas works. I know nothing about the explosion itself. I had the management of making all the joints of the still used by Mr. Hodgetts which are in sight. It is a cast-iron still; it was perfect. The top joints are sockets cemented. The still was in two parts, the top part dropping inside the other, and the two being cemented together. I have examined the still since the explosion, and the joints are good except this, which you cannot see on account of the brickwork. That is the joint of which the last witness spoke. I cannot form any opinion as to the state of that joint. The cause of the accident would be that, as soon as the water was taken from the lead tube by Mr. Hodgetts letting it off, the pressure of the steam would burst the pipe, and the naphtha rushing out would become ignited from the fire which remained in the ashhole, and thus set the whole place on fire. I have no doubt that that was the cause of the accident. I had not superintended the making of the joint between the two parts of the still. The oil could not have escaped by means of that joint, as supposed by Collier, because, had it been so, there would have been a positive explosion, and the whole of the brickwork would have been covered with pitch.

Mr. Stephen White said: I am the principal in the firm to whom this manufactory belonged. The works were left entirely under Mr. Hodgetts' care. He was a practical manufacturing chemist, and had been so for fourteen or fifteen years in Salford. I was at the works on Tuesday and yesterday morning. Everything then appeared to be perfectly satisfactory. My opinion as to the cause of the accident is that while the oil, consisting of naphtha, paraffine, and other like oils, was in process of distillation, the paraffine, being a hard, waxy substance, passing over into the condenser with the naphtha, had congealed or solidified in the worm, and, no vent being given for the other condensed vapours, a very high pressure must have been caused in the body of the boiler, and that ultimately the lead pipe or condenser burst; at the same time a syphon had been forced by means of the neck of the still, and the contents of the boiler must have been syphoned out, and received into the tub, and have overflown into the fireplace, thence taking fire and causing the accident. The diameter of the worm was, I think, about five inches at the top, and one and a half at the bottom. The plan to have been adopted as soon as the obstruction was discovered was to have punched a hole in the worm and left the premises, when the thing would have remedied itself. It was very imprudent of the deceased letting the water run off and then getting up where he did; because, when lead becomes above a certain heat, it gets quite rotten. He might as well have been on the top of a high-pressure boiler. I account for the presence of the paraffine in the worm by the fact of there not being heat enough in the fire during she night; so that, though the paraffine had been separated, the naphtha had not been carried off. When paraffine gets into the worm it may be blown out by steam. I do not think anything of the nature of an explosion could have taken place, but only a rapid combustion. I believe Mr. Smith yesterday suggested the propriety of having a safety-valve on the top of the still. [Smith confirmed this, and said he had not the least doubt but that, had the accident not occurred, such a valve would have been fixed.]

Francis Gallaghan said: I am a chemist in the employ of Mr. M'Guire, whose premises immediately adjoin those where this accident occurred. When it happened I was at work on the other side of the wall, and, hearing the explosion, ran and told my master. We saw the place was on fire. I ran round to the fire and found no one there. I went to the back part of the flames and saw Mr. Hodgetts coming out from them. He fell down about twelve yards from the place, under the shed. He never spoke. He was all on fire. I went to pull off his clothes, then got a bag and covered him with it, and then threw on it some water. He gave three breathes while the water was going upon him. I was first alarmed by a small shake, and then a small crack, and a roar. It was like three cannons going off one after another very loud, and shook the street.

Mr. White, having been appealed to by one of the jury, said he could not understand how there could be an explosion.

The Coroner said he thought that, as the evidence stood, it must resolve itself into a case of accidental death.

The jury immediately returned a verdict of "Accidental death."

An inquest was subsequently held upon the body of Jonathan Lowe before Mr. Rutter, the coroner, and the same witnesses having been examined as gave evidence on the inquest upon Mr. Hodgetts, the jury returned a verdict of "Accidental death."

Another victim of this fearful accident, named Cliffe, expired after the above was in type, making the third. An inquest was held, and the same verdict returned as in the previous cases.

HYDRO-CARBON GAS.

(Abridged from the Manchester Guardian.)

In January, 1849, we reported at some length two lectures delivered by Mr. Stephen White, the patentee of the hydro-carbon gas. Since that period it has been introduced into use at Ruthin; the town of Southport has been lighted by it; and two manufacturers in this neighbourhood are now lighting mills with it—we refer to Messrs. Travis Brothers, of Lusley Brook, near Oldham, during the last four months; and Messrs. George Clarke and Co., of Hope Mills, Pollard-street, Manchester, during the last eight weeks. The patentee having made some improvements in the production of the gas, a reporter from this office attended, by appointment, at Messrs. Clarke and Co.'s mill, on Thursday afternoon, to witness some experiments. Amongst the gentlemen present were Messrs. C. Clarke, Henry Houldsworth, J. C. Dyer, James Gibb, J. H. De Castro, Edwin Travis, James Miller; Stephen White, the patentee; and Hawkins, who has had the management of the gas works at Messrs. Clarke and Co.'s.

Before noticing the experiments we may state that Messrs. Clarke and Co. have never lighted their mill from the Manchester Gas Works. They erected the necessary apparatus, on an adequate scale, on their own premises, for the manufacture of the ordinary coal gas, consisting of nine horizontal and cylindrical retorts, about 6 ft. in length, and about 14 in. inside diameter, which supplied them with an average quantity of 18,000 to 20,000 cubic feet daily. A short time since they entered into an arrangement with the patentee of the hydro-carbon gas to supply that gas to the extent required for their own mills, for a certain term, at the rate of 1s. 8d. per 1000 cubic feet; he being at all the cost of the retorts, fixing apparatus, and providing meter, &c. Their gasholder was, of course, applicable to the new gas, and the only change requisite was in the retorts and the preparatory vessels. The nine retorts have been replaced by four, which do all the work formerly done by the nine. One pair of retorts are of the D form, horizontal, 6 ft. 4 in. in length, and 14 in. diameter. The other pair are of the L form, vertical, 6 ft. 9 in. long, and 14 in. in diameter; so that the four retorts for the new gas are a little longer, but of the same bore, as the nine for the old gas; and, as we have said, these four, very little exceeding the dimensions of the others, do the work of eight or nine of the old ones. The person who had had the management of the old retorts stated that in winter he was accustomed to work eight of the retorts, and the quantity of gas from the four now in operation was quite as large. Indeed the consumption of the mill during one week in which there were several foggy days was 119,000 cubic feet of hydro-carbon gas; and the daily average consumption of the mill during the winter is 17,000 to 18,000 cubic feet. The other day, we are told, 800 cubic feet of the gas was made from one pair of retorts within an hour; and, with all four retorts in action, 1000 cubic feet an hour can, it is stated, be easily produced.

The "raw material" of which this gas is produced consists of resin, water, iron, and charcoal. The proportions are 1 cwt., equal to 12 gallons, of melted resin; rather less than two gallons of water (15 pints); about one-sixth of a bushel of charcoal; and about a quarter of a pound of common scrap iron. These ingredients, we are informed, will produce on an average 1500 or 1600 cubic feet of gas, and three gallons of residual oil. But it is right to state, that to two parts of resin is added one part of this residual oil, and these are put

together into a boiler to melt, and the mixture then passes into a tank, and thence is carried by a syphon into the D retort, where it is subjected to the action of heat and converted into gas. The water is supplied by pipes to a tun-dish, and thence by syphon to the L retort, where it is decomposed and becomes gas. The two gaseous products are mixed, and become hydro-carbon gas in the D retort, and thence pass up the ascension-pipe to the hydraulic main, and so into the condensers and purifiers; after which it passes to the meter and gas-holder. There are at Messrs. Clarke and Co.'s two purifiers, each containing three perforated trays, by means of which the gas is passed through lime. Above the purifiers is one washer, which is found sufficient for this gas, though three were used for the ordinary gas. The residual oil which comes from the retorts, and is received in an open tank, is stated to give three valuable products, viz., of highly-rectified naphtha, with a specific gravity of ·855 (and coal naphtha is said to be never under ·875 and often ·880)—12½ per cent.; of light oil, 18 to 20 per cent.; and of heavy oil, 55 per cent. These oils are said to be very useful for paint and pigments. To these residual products must be added about 12 per cent. of pitch.

The first experiments of Thursday were to ascertain, by means of a test-meter (that of Mr. Thomas West, of Oldham), the quantity of gas consumed per minute, when the flame was brought to the same illuminating power as that of a wax candle of six to the lb. The candle was a patent one, stamped to burn equally, and warranted not to vary in size. The gas flame being adjusted, and the candle placed on the same level and line, within a few inches, with a calico sheet on the wall behind, and another on the more distant wall in front, and between the light and the latter sheet an upright iron rod, so that the two lights should be equalized by a careful comparison of the two shadows cast by the rod on the sheet,—these preliminaries being adjusted, the experiments commenced, the pressure on the gas, as shown by the gauge attached to the test-meter, being 1·2 inch. By several seconds watches the gas passing through the meter giving a light equivalent to a wax candle was in one minute rather more than 5-10ths of a foot; in the second minute, barely 5-10ths; and in the third minute, exactly 5-10ths. These experiments appeared to show that, on the average, half a cubic foot per minute of the hydro-carbon gas gives a light equal to a wax candle of six to the lb.

In order to conduct the same sort of experiment with the gas of the Manchester Gas Works, it became necessary to go beyond the premises, as Messrs. Clarke and Co. do not burn any of the town's gas. The test-meter, &c., were taken across Pollard-street to a tavern, and placed in a front room, which was darkened by closing the window-shutters, and from one of the lights supplied from the corporation gas works a pipe was attached to the meter, and the candle, sheets, &c., adjusted as before. It was about four o'clock, and it was found that the pressure, instead of being 1·2 inch, was not more than 0·3 inch. Some experiments were made under this deficient pressure, but we shall not record them. At length more pressure was obtained, and by means of the lower taps it was adjusted to 1·2 inch, as in the case of the water gas, and then the experiments gave the following results:—In the first minute 5½-10ths of a foot; in the second, rather over 5-10ths; in the third, 5-10ths. These results are so very nearly the same with those before obtained from the hydro-carbon gas as to justify the conclusion—so far as a non-scientific person can arrive at it—that in this respect the two gases are as nearly as possible equivalent in quantity.

Other experiments with the hydro-carbon gas, the same flat-flame burner, but using the full power, showed that the consumption to produce a more than ordinarily strong light was 2·6 feet or 2·7 feet per minute; so that 2½ cubic feet per minute would give a very good light. Mr. E. Travis stated that the hydro-carbon gas he made gave 14 per cent. of olefiant gas, and that the town's gas never exceeded 9 per cent. of olefiant gas.

The quantity of gas which the four retorts would make was tested, during short spaces of time, by the meter by which Messrs. Clarke and Co.'s consumption is gauged. One minute, 28½ cubic feet; the second minute, 24 cubic feet; and the third minute, 29 cubic feet. These give respectively 1480, 1440, and 1740 cubic feet per hour, from four retorts of the dimensions stated above. It was stated that from this apparatus 20,000 cubic feet in the twenty-four hours was considered the proper work to keep up; though much more could be made in that time.

The hydro-carbon gas when supplied to one of Wingfield's patent lucescent burners, No. 1, certainly gives out a most brilliant, pure, and splendid light. It is clear, white, and, even when the full power is turned on, it does not change these characters, but forms the most pleasant and brilliant light we have seen, short of the electric light.

In the course of the experiments some questions were asked and statements made, of which the following were the most important:—In answer to a question as to the character of the gas in the mill during the last few weeks, Mr. Charles Clarke said there was no complaint of it either as to smell or anything else. It was, he thought, as good as the town gas. They had had it now six or eight weeks throughout the mill, with the exception of the last week, during which the mill was partially stopped.—Mr. H. Houldsworth: Have you any deposit in your pipes? Mr. C. Clarke: Not in the least.—Nothing in the burners or holes? Nothing.—No rimmering? No.—Then, it lights the machinery as well as the old gas? Quite.—Subsequently, Mr. Edwin Travis said that he had produced 2000 cubic feet of this gas from a cwt. of resin, using water sufficient to prevent smoke from the lights.—Mr. Hawkins (manager of the gas works at Messrs. Clarke and Co.'s) said he found that he got from 1700 to 1800 cubic feet of gas and three gallons of residual oil from one cwt. of resin.—Mr. Travis said that from the last barrel of resin the product at his mill of one cwt. was exactly 1754 cubic feet. It being now nearly five o'clock, the experiments terminated.

We understand that the usual terms on which the gas is supplied are for the patentee to fit up the retorts, meter, and other apparatus, making his charge for it, and then receiving one payment of 5s. per light for every light used, except an enormous number are required, when the terms are lower. We were told that Southport is now paying these terms, and that Messrs. Travis Brothers are also making the gas themselves on the basis of a similar arrangement. We have stated that Messrs. Clarke and Co. for a limited period preferred that the patentee should take the responsibility of supplying the gas, and are paying him 1s. 8d. per 1000 cubic feet.

If this gas can be produced at this rate, and there be no fallacy in the experiments we have described, which seem to show an equal consumption of this hydro-carbon gas and the town's gas, under similar circumstances and conditions, there would certainly appear to be economic reasons for giving Mr. White's gas the preference. But none of the experiments of Thursday tested the relative illuminating power of the two gases, and, as there was no disinterested and impartial scientific gentleman present, the experiments must not be accepted as conclusive, but only as approximative. Dr. E. Frankland, professor of chemistry at Owens College, would have been called in, but he was in London; and another scientific chemist, who had promised to attend, subsequently declined. However, enough has been stated and shown to warrant a close and careful comparison of the two gases, not for a few minutes merely, but on a large scale of manufacture, and extending over days and weeks, under conditions as nearly alike as it is possible to secure.

Since the above was in type we have received from the patentee's office the following description of the process of manufacturing his gas:—The patent apparatus consists of two horizontal retorts, designated D retorts, from their peculiar shape, measuring each about 6 feet long, by an average diameter of 14 inches; and of two vertical retorts, called L retorts, being each about 7 feet long by 9 in diameter. These are placed in a furnace, measuring internally 4 ft. 3 in. by 6 ft. 6 in., and so arranged as to economize the fuel necessary for getting up the requisite heats. The gas is produced from resin and water; the resin, mixed with residual oil, being melted in a small vessel outside the gashouse, is syphoned into the D retort in a liquid state, and is decomposed therein. The water is syphoned from a small tank into the L retort, and enters at its top, and is decomposed in passing over charcoal and iron scraps at a high temperature. The gas thus produced enters the D retort by a connecting-pipe, and in passing through its chambers becomes permanently united with that produced from the resin, forming in this compound state the hydro-carbon gas. The remainder of the apparatus, in general principles, is very similar to that used for coal gas, with the exception of the purifiers and washers, which are considerably smaller than those required for the coal gas. Those parts of the resin and oil which are not decomposed in passing through the retorts are reduced to a vapour, and are condensed in passing through a hydraulic main and condenser, and produce the residual oil alluded to, which is found by chemical analysis to contain an excellent naphtha, oil, and other products.

GASFITTERS' ASSOCIATION.

MR. GORE'S LECTURE ON GAS AND GAS-LIGHTING.

The usual monthly meeting of this association took place at their Rooms, St. Martin's-lane, on Tuesday evening, March 3. Mr. George Dethridge presided.

Mr. H. GORE addressed the society nearly as follows:—Gentlemen, in calling your attention to the subject of gas and gas-lighting, perhaps some of you will be disposed to say that it is rather a hazardous experiment to mention our opinion upon a subject respecting which there is so much disagreement amongst the majority of those who profess to understand it most. I venture to say that there is no subject which occupies the attention of the engineering and chemical profession upon which there is such a diversity of opinion as upon matters connected with gas. It appears that gas is one of those peculiar compounds that may be produced under almost every circumstance and in different modes with totally different results. In fact, it appears that gas-manufacturers cannot regulate their operations by any well-defined system. If you go to a gas-manufacturer in England, and ask him a few leading questions respecting the manufacture of gas, you will receive a certain number of answers in return; but if you proceed upon your journey a few miles and enter a second factory, and ask the same questions, you will receive answers totally different from those you had previously received. This being the case, it cannot be wondered at that the science of gas-lighting should be comparatively in its infancy. There can be no doubt that all gas-manufacturers will agree that the object they have in view is to produce certain results by the decomposition of organic matter. Before we can enter into anything like a detail of the method of producing gas, it is as well that we should say something of the probable origin of the material from which this very important agent is produced.

And, first, with respect to the origin of coal.

Coal is the *débris* or remains of vegetable matter. It is very well known to every geologist, chemist, microscopist—indeed, every one who has investigated the subject—that coal derived its origin from vegetable sources. This being the case, it is necessary for us to detail the different stages through which coal has passed before it presents itself to us as the ordinary mineral coal of commerce or art. When matter passes into an inorganic condition an important change takes place in the various atoms of which it is composed. For instance, the chemist takes a mass of iron, and, by combining it with oxygen, produces the oxide of iron. Again, he may take any of the inorganic substances, and, by combining them in certain proportions, produce compounds perfect in their character, which, under ordinary circumstances, will remain in the state in which they are placed. But no chemist, however skilful, can take the elements of which any organic substance is composed, and by a simple union of those elements, as far as they have been ascertained, produce a similar organized sub-

stance. For example, the product of certain saccharine matters and woody fibre gives a certain kind of spirit; but we cannot by any art of the chemist produce pyroligneous ether. It is totally beyond the art of the chemist, by combining the elements of which any organized body is composed, to produce organic matter. Now, it is organic chemistry that is brought into operation in dealing with gas. All vegetables contain certain elements combined in various proportions. The three great elementary principles are oxygen, carbon, and hydrogen. These are combined in certain proportions. The two most important are those which give acid compounds and those that give resinous compounds. Those that give acid compounds contain oxygen in excess; those that give resinous have hydrogen in excess. When the hydrogen of which vegetable matter is composed consists of a larger proportion than is necessary to form water, we have resin; when it contains oxygen, we have acid. Acid compounds are the result of destructive distillation. In speaking of coal as forming one or other of these ingredients, we must assume that the vegetable matter from which coal derives its origin contains hydrogen in excess, and, containing hydrogen in excess, we can readily understand how, in the process of time, a certain portion of hydrogenous matter is evolved in the shape of water. We have, however, sufficient hydrogen left behind which gives in destructive distillation the gas which we derive from ordinary resin. But, to show that this is carried on irrespective of manipulation, we find that large quantities of ordinary gas are derived from the destructive decomposition of the coal through the different fissures in the earth, where the vegetable matter from which coal derives its origin is deposited.

[Here the lecturer directed the attention of his audience to a diagram of the Jarrow colliery, in which diagram various faults were portrayed from which were evolved large quantities of hydrogen gas, known as the firedamp. The object of the lecturer was to show the possibility of gas being evolved without the employment of any human agency.]

Those who had read the public prints a few years ago would recollect a vast catastrophe that had occurred in this colliery. The accident was of so serious a character that a Government inquiry was instituted, in which Professor Playfair and Sir Henry De la Beche took an important part. This accident proved that carburretted hydrogen is the product of destructive distillation from vegetables containing large quantities of resin. The same circumstance was fully proved from observations at the Busonne colliery, in Belgium, where the products of destructive distillation issuing out of one of the fissures, on being lighted, formed a flame eight feet in length in the atmosphere. This shows that the coals or materials themselves may be exhausted of their volatile matter before removed from the mines; for, as the gaseous or volatile matter became evolved, the coal became gradually of less and less value for the purpose of gas manufacture. Hence it happens that there are certain descriptions of coal totally unfit for the manufacture of gas, inasmuch as they had been entirely robbed of the whole of their gaseous matter. The anthracite of Wales and Ireland, and a great proportion of the anthracite of America, are for this reason without any value, as far as the manufacture of gas is concerned; because their bituminous or resinous matter had been driven off, and they had been converted into solid coke or carbon. But we have similar proofs even in coals which, ordinarily speaking, are fit for gas purposes.

In the great slip or basaltic dyke which passes across the great northern coal-field, commonly called the ninety-fathom dyke, because the stratum of coal is thrown up to the distance of ninety fathoms, there is a great fissure running up through the whole stratum, and on each side of it there are large quantities of solid carbon, not the ordinary coal, but coke which does not contain a trace of volatile matter in it. On each side of this dyke, for nearly thirty feet in width, this coke is to be found. This shows that the extreme heat of the fluid lava had effected a decomposition of those materials. If we would only study nature in her various processes, we would arrive at correct results a great deal more rapidly than we could by mere theory. We are too apt to go a roundabout way to work when we want information, rather than ask the question from nature, from whom we would be always sure to receive a true and decisive answer. The best course to pursue in all inquiries of this sort is to follow the guidance of nature. This is true science. When science is talked of, persons are supposed to think of something in the chemist's laboratory or philosopher's studio; and they are also puzzled by the difficult nomenclature employed by scientific men; but my notion of science is, that it is the simplicity of truth itself. A man who says he is an unscientific man tells me at the same time that he is an untruthful man. (Applause.) Some imagine that the less they know of science the more practical they are in their pursuits. I think otherwise. I wish to know more and more of science, and I think the more scientific we are, whatever our pursuits may be, whether in gas-lighting or otherwise, the more perfect and satisfactory will be the results of our investigation. Having said so much of the source from whence we derive our material, I must now say something of the history of gas-lighting.

The first step for gas-lighting purposes was taken about the year 1803, when Messrs. Murdoch and Watt proposed to establish a gas-foundry in Soho. Mr. Clegg, in 1807, introduced it into the Catholic College in Stonyhurst, Lancashire. Winsor, in 1808, carried on his operations in Pall-mall; and perhaps some of you remember the lectures which he delivered in the Lyceum Theatre on gas. About that period the first act of incorporation of any gas company was passed; I believe in 1810. There is some misapprehension as to the motives which induced the Parliament to throw out the bill introduced in 1809; but, from some records of that date, I find that Bolton and Watt, on behalf of Murdoch, opposed the bill, on the ground that they were entitled to a monopoly of the manufacture of gas. They considered that the bill of 1809 was trenching on their rights. It is well known, however, that the Chartered Gas Company obtained their act in 1810. And here, by way of digression, I cannot help saying a word or two on an appeal to what is termed "experience." I do not for a moment undervalue experience. I do not deny that experience, if rightly directed and properly applied, is worthy of every respect that can be paid to it; but we must not elevate ignorance, prejudices, and obstinacy to the position which experience alone should occupy. As a remarkable instance of the value of science, I may state that Sir Humphry Davy—a man whose name was a word for science and truth itself—when he was asked for his opinion as to the probability of lighting London by gas, said he should as soon have expected to see London lighted by gas as that the Corporation of London would get the dome of St. Paul's for a gasholder. The effect of this opinion on the part of Sir Humphry Davy almost paralyzed the efforts of those who wanted to promote gas-lighting, and nearly deprived them of all public patronage. Mr. Brande told him (Mr. Gore) that he (Mr. Brande) formed one of a commission appointed by the Government to visit the works of the Chartered Gas Company, in order to ascertain the proper size of the reservoirs into which the gas was to be introduced; and, referring to some notes which he made on the occasion, he said he proposed a maximum of 3000 cubic feet. Sir J. Banks thought there would be no danger if the gas were retained within strong walls, and they might then go as high as 6000 feet; and it was ultimately decided, on the recommendation of the report sent in by the Government commission, that the limit should be from 4000 to 6000 feet of any reservoir to supply the metropolitan districts with gas. Now, these men were sent for and examined on the ground of experience. This teaches us a useful lesson; namely, not to attach too much importance to opinions, unless they are backed and supported by philosophy and science. By way of illustration I may also notice a very remarkable circumstance in connection with the late George Stephenson. When the bill of the Liverpool and Manchester Railway was before the House of Commons a commission was appointed to inquire into the capabilities of the railway, in order to ascertain how far Parliament would be warranted in granting the bill. The opponents of the bill took care to have all the men of "experience" examined on the opposition side, in order to give every possible weight to the opposition. The counsel for the bill on that memorable morning when Mr. George Stephenson gave his evidence had Mr. Stephenson to his chamber, to confer with him. The counsel on that occasion said to Mr. Stephenson, "Really, I think that if you would give way a little with respect to what you propose to accomplish there would be more probability of success." Mr. Stephenson said, "In what point do you wish me to give way?" The counsel said, "In reference to drawing a hundred tons by a locomotive at the rate of fifteen miles an hour. Just consider that we shall have the most experienced men to contend against us." "Well," said Mr. Stephenson, "I do not want to use any of John Jolly's or John Joiner's horses to draw the load, and I see no difficulty in the matter." But when before the committee of inquiry he was asked if, with such a load, he could go twelve miles an hour, his answer was simply, "Yes;" and when he was asked if he could go twenty miles, and he returned the same answer, then the chairman said, "We do not require any more evidence to show the perfectly Utopian character of the project." But Mr. Stephenson said, "I cannot be satisfied till I see the day when, instead of going twenty miles an hour, I shall go fifty, and carry double the load." This rough, unhewn diamond was then so thoroughly satisfied of the truth of the principles he laid down, that he was quite willing to contend against what was called the experience of the day; and we all know that on the first day the line was opened he took double the load at twice the speed. (Hear, hear.) With respect to the modern history of gas-lighting, I think the public are going a little too fast ahead, to use a Yankeeism. They seem to entertain the idea that a gas manufactory can be erected in the corner of every street, and that we can have as much competition between gas companies as between bakers or grocers. I believe that there may be over-competition with respect to the production of gas, and that it is for the interests of all parties to be thoroughly united. If the public and the gas companies are not united, it is impossible for either party to have ultimate success.

It is not my intention this evening to trouble you with any detailed experiments. I do not think that a meeting of gentlemen connected essentially with gas manufacture require any lecture-table experiments to prove the various facts I have to enunciate. In the manufacture of gas we should copy nature as closely as possible. We know very well that certain bodies may be decomposed by the use of various means. For instance, if I bring two bodies together, the atoms of which have different affinites, we can readily understand that the elements of each will have a greater affinity for each other than the bodies themselves—that is, that they will more readily enter into combination. But this would be simply elective affinity. We are to take into consideration another law of nature affecting decomposition. Suppose, for instance, we have to decompose this piece of coal. We find that it contains carbon, hydrogen, nitrogen, and oxygen, in certain proportions, combined with lime, silica, sulphur, iron, and other impurities. Our object is to obtain, for the purpose of gas manufacture, three ingredients, namely, carburretted hydrogen for light, the compound of nitrogen for chemical purposes, and the unconsumed or uncombined carbon for the purpose of fuel. [Referring to a diagram of retorts for the purpose of manufacturing gas, the lecturer then explained the process by which the volatile matter was separated from the coal, and made applicable to lighting purposes.] Heat was the agent by which the work was effected, and it was, therefore, of importance to know the best means of applying that heat so as to effect the object in view in the most speedy, economical, and satisfactory manner. In order that the required substances might be evolved in sufficient quantities we must have a sufficient amount of heat, for, if we wanted to extend a piece of coal to 270 times its bulk, the amount of heat applied must be equivalent to the force requisite to produce such a separation and expansion of its atoms. Those atoms, it must be recollected, had no disposition in themselves to move. The expansion must, therefore, be effected by some external agency, and rightly applied. In order

to produce gas the coal must be expanded to 270 times its bulk, and, if the amount of heat applied does anything less, then, instead of producing gas, we should only produce a liquid. Now, every cubic inch of tar produced was so much illuminative matter wasted and lost; and he held the opinion—an opinion derived from a considerable number of experiments—that when once tar was produced, if it were attempted to decompose it with gas in the same retort, instead of producing the required result, the product would be a greatly increased quantity of that very objectionable material called naphthaline. The heat applied to the retort should be sufficient at the outset to produce the maximum quantity of gas. They all knew that the greatest proportion of tar was produced in gas retorts during the first two or three hours. This was accounted for on the principle that the temperature in the retort—or rather the amount of caloric in the fuel taken up by the volatile products of the coal—was not sufficient to maintain the material in a gaseous form, and therefore a large quantity of tar was produced. The production of gas was not in a uniform ratio. In the first three hours the greatest proportion was produced that could be obtained from a single charge of coals. But some would say, "If you use such a high temperature you will melt the retort." He did not think such a result would take place so long as there was a sufficient amount of gas evolved to carry off the heat given to the retort.

The lecturer then drew attention to several kinds of retorts, of which he exhibited drawings, and, having explained the peculiarities of each, remarked that scarcely two companies had agreed as to which was the best. With respect to the time to which the coal should be subject to the process of distillation, Mr. Gore observed, that at one time it was considered very methodical to charge the retort three times in the twenty-four hours. Eight-hour charges were considered satisfactory, economical, and advantageous. His notion was that the oftener they could charge the retorts the better. By continuing the charges for too long a period a large portion of impure matter in the shape of sulphur is evolved. Sulphur entered into close combination with coal. A piece of coke which he held in his hand, though it had been exposed to a white heat, was found by analysis to contain distinct and palpable traces of sulphur. That circumstance served to show that gas produced from charges of long duration contained a larger amount of impurities than gas produced from frequent charges. A gentleman then in the room, in speaking of the duration of charges, said it would be better if gas companies turned the products of those long-hour charges into the furnace than send them to the public. If companies were to attend more to the duration of those charges, there would be less complaints about the impurities of gas. (Hear, hear.) With respect to the condensation of gas, or that process by which the gas when it left the retort passed from the hydraulic main into the air-condenser, he wished to observe that, if the temperature was reduced below a given point, the illuminating power would be materially injured. The usual mode employed in condensing gas was by the direct application of water to the gas, or by causing it to pass through vessels whose surfaces were kept cool by water. The most simple arrangement for condensing gas was that of the ordinary air-condenser, in which a large number of pipes were used. The temperature should never be reduced below from 65 to 50. Below that range the quality of the gas would be materially injured.

Mr. Gore next proceeded to explain the principle of the apparatus called the "scrubber," which he considered a most efficient instrument in purifying gas from ammonia. Gas contained a great quantity of ammonia in the shape of carbonate and hydrosulphate. After the larger portion of the sulphuretted hydrogen was taken out by means of the lime-purifier, still a considerable quantity of ammonia would remain in the gas. After all the ordinary processes of purification were employed, ammonia would still be held in suspension; and, when ammonia was consumed with the gas, his opinion was, that cyanogen would be the result. Many persons differed from him in that opinion, but he was satisfied that cyanoid salt was produced from the combustion of gas when ammonia was present. This was necessarily so, inasmuch as, when we produce cyanogen, all we had to do was to combine carbon and nitrogen in definite proportions. If cyanogen was the result of carbon and nitrogen, then impure gas must of course contain a large proportion of the ammoniacal element; for the nitrogen, uniting with the carbon, would very readily give rise to a cyanic compound. By passing the gas through a scrubber such as he had described, the greater portion of the ammonia would be taken out, and what remained would be inapplicable by the most delicate tests. He did not know whether his friend Mr. Wright, in his honest and praiseworthy efforts to provide pure gas, might not by his tests show that we had yet some ammonia left after the ordinary process of purification; but he (Mr. Gore) was merely remarking that its presence could not be detected by the ordinary tests.

The lecturer, having described the wet-lime purifier and the dry-lime purifier, gave the preference to the latter. The advantage of the dry-lime purification was, that the minute division which took place in separating each atom of lime from its neighbour caused so many interstices that the gas, in passing through them, came into contact with a much larger portion of lime surface than when it passed through lime in the wet condition. He was so satisfied of the importance of dry-lime purification that he should make it a *sine quâ non* that dry-lime purifiers should be employed in every gas manufactory. The wet-lime purifier had the advantage of being cheaper, but cheapness should never be taken into account in a question relating to the purity of gas. Another important advantage in the dry-lime process was that the waste from the dry-lime purifiers was applicable to important agricultural purposes, whereas the waste of the wet-lime was for the most part a drug on the hands of the gas-manufacturer, and often gave rise to litigation, from the unpleasant nature of the products and the nuisances which they occasioned. It was, however, to be lamented that there was scarcely any unity of plan pursued by gas-manufacturers themselves, for scarcely two of them adopted the same process. One word as to the chemical nature of pure and impure gas. When we made use of gas for the purpose of light we should remember that, however advantageous it might be to us to have it perfectly pure, yet we could not obtain artificial light without having a certain amount of residual products. The light from the sun left no products whatever; but all artificial light must of necessity yield products, because matter, though it might undergo change, was perfectly indestructible. Whether a certain mass of coals were consumed in a fire or furnace, or in a gas retort, the amount of the weight of the products would be always the same. We should still have the carbon of the coal uniting with the atmosphere and producing carbonic acid, and the hydrogen of the coal producing water, and the nitrogen given to us in the same condition, and all the remaining products remaining to us, only having undergone a change as to form. Therefore it was a matter of importance to us that, in any material to be used for the purpose of giving light, its products should be as innoxious as possible. If we, then, took coal in a perfectly crude state, and submitted the gas derived from it for the purpose of illumination to a test, we should find that it contained, first, a quantity of sulphuretted hydrogen; we should have the carbon and oxygen uniting together, giving us carbonic oxide and carbonic acid: both of these were deleterious. Then we should have the carbon and nitrogen combining together, and giving us the cyanogen, which was the base of prussic acid, a well-known poison. We should have hydrogen and oxygen combining together and producing water; then the hydrogen and nitrogen combining together and producing ammonia; we should then have the oxygen and nitrogen combining together and producing nitrous acid; so that these elements in their compositions would give rise to (with one exception) a mass of poisonous products. But, if we could get rid in our gas of the oxygen and nitrogen, we would then have brought down our absolute poisonous products to carbon and hydrogen; and this, in the process of combustion, uniting with the oxygen of the atmosphere, would give us carbonic acid gas. Formerly there was no test but what was called "the commercial test." It was done by placing an ordinary silver coin opposite the gasburner, issuing from some part of the works. If the coin was blackened, then it was thought that the gas was totally impure. He knew an establishment not fifty miles from London where they never had the slightest idea of employing any other test for the purity of the gas except a shilling. His friend Mr. Defries knew well the locality referred to, as he had made some important investigations connected with it. When he (Mr. Gore) told them that sulphur in a state of combustion must be injurious to health, they would readily understand the importance of removing every trace of sulphur which the gas might contain; for many of them must be aware of the great complaints made throughout London respecting the effects of impure gas on goods in linendrapers' establishments, and on books, bindings, &c.; and this was owing to the sulphurous acids produced by combustion.

The lecturer then referred to a very beautiful instrument invented by Mr. Wright for the purpose of detecting sulphurous acid in gas. He held in his hand a compound containing a certain quantity of sulphuretted hydrogen; by pouring into that a quantity of acetate of lead, black precipate was the product. This was a test which might be employed in connection with any ordinary purifier. Mr. Wright, however, believed that certain compounds of sulphur in a finely-divided state might escape the tests. He (Mr. Gore) was not prepared to contradict that opinion, nor was he satisfied that we had yet arrived at perfection in connection with the purification of gas. Mr. Wright's very beautiful apparatus was entitled to the approbation of every one connected with the manufacture of gas. (Cheers.) It was a most simple form of manipulation, and it showed what might be done by studying nature in order to obtain correct results.

The lecturer was then proceeding to apply Mr. Wright's test to the gas then illuminating the room, but

Mr. Wright rose and stated that he had an objection to having it stated whose gas they were then consuming; that on putting that instrument on the table he had no desire to have an experiment made which might be detrimental to the character of any company. (Hear, hear.) He was far from being actuated by any party spirit. (Hear, hear.) While he was ready to fight his own battle, on his own grounds, he did not wish to do anything that might have an invidious character. He had invented the instrument, and would give it to the engineers generally. He was sure that in using it, if they found sulphur in any gas, they would soon rectify the process of manufacturing it. (Hear, hear.)

Mr. Gore said he was thoroughly satisfied that he should obtain sulphur from the gas, because it was conveyed through an indiarubber tube to the burner, and the gas in passing through that would decompose a certain portion of the material of which it was made. The fact of their having found a deposition of sulphur in the water extracted from the gas by Mr. Wright's instrument was not in itself a sufficient proof that there was sulphur in the gas. It was their duty as experimentalists to take into account the medium through which the gas was conveyed. This circumstance showed the importance of having all the elements of an experiment so arranged that they would not tell us a false story. He could relate a circumstance in connection with gas manufacture to prove this position. It would be remembered, in reference to the recent bill before the House of Commons for granting powers to the Great Central Gas Company, that a number of experiments were made in reference to the illuminating powers of gas. A number of scientific gentlemen of undoubted character and capability were employed to analyze the gas of several companies, and the results were so extraordinary as to call for further investigation. In one case it had been found that, through the apparatus employed, a quantity of atmospheric air was inadvertently admitted, and therefore the gas was of an illuminating power far below what was requsite for lighting purposes. This showed that in the most experienced hands mistakes might occur, and it showed also the importance of taking all the circumstances into careful consideration, so as to place the result beyond the possibility of doubt or suspicion. But the most important object

which could engage the attention of the gas-manufacturers was to get rid of the residual products. This subject had been recently brought under their notice in the lecture delivered before the gasfitters by Dr. Bachhoffner. He (Mr. Gore) was satisfied that the gas companies and gasfitters suffered materially from the circumstance of parties using large quantities of gas in situations where adequate provision was not made for ventilation. The products must be carried off, and, when suitable arrangements were not made for that purpose, the consequences were attributed to the impurity of the gas or the want of tact in the persons making the fittings. A case of this kind had lately occurred in Blackheath. There a gentleman had in a room about twelve feet square a three-light chandelier. There was no ventilation, that being the last thing an Englishman would think of, his main object being to keep himself surrounded with warm air rather than pure air. This gentleman was constantly complaining of headache. His medical adviser told him the gas was not good; on complaining to the company which supplied it he was informed that he had too much light in proportion to the current of air—that, in fact, he had a quantity equal to that which twenty-six candles could supply, and that what he wanted was ventilation. He got a ventilator put into the window, and the result was that the headaches left him, and the gas was found very satisfactory. If the public did not provide ordinary means of preventing danger or inconvenience, it was not surprising that they should feel sometimes annoyed. He threw out this hint because he knew that gas must be used far more extensively than it was at present. Gas must eventually become the light of the masses, and until that was the case it would not have performed its mission.

With respect to the values of gas derived from the different qualities of coal much might be said. It was a vexed question. It had been frequently said that, if Liverpool gas was 4s. 6d. per 1000 feet, London gas should be 2s. 6d. So it should, perhaps, in reference to light; but he questioned very much whether the same arrangements employed in Liverpool for the production of gas were applicable to London. First, they should look at the means which the gas-manufacturer had in London of getting rid of his residual products. In London an important item in the manufacture of gas was the amount of coke, or fixed carbon, derived from it. It was said some time ago that gas companies were coke-manufacturers,—that the production of coke was more their object than the production of gas. With some of them, perhaps, that was the case; but now the manufacture of gas was the main object. It was well known that the quantity of the gases derived from various kinds of coal depended upon the relation that existed between the carbon and hydrogen. If the coals usually used in London were compared, their gaseous elements would assume something of this standard:—

	Cannel Coal.		Newcastle Coal.
Carbon	81·2	..	67·6 per cent.
Hydrogen ..	8·7	..	20·3 ,,
Oxygen	4·6	..	5·4 ,,
Nitrogen	5·5	..	7·7 ,,

Hence it should be expected that from cannel coal we should obtain less coke than from Newcastle. The former description of coal yielded a much larger quantity of gas, and of a greater illuminating power, than that of the latter. He knew from experiments that the cannel coal gas of Liverpool was in the proportion of 12 to 22; that was, it would take 22 parts of London gas to give the same illuminating power as 12 of Liverpool. There could be no question as to the illuminating power and superiority of the light from cannel coal gas, but, then, the question came—"In what ratio can we supply cannel coal gas, so as to pay a remunerative dividend to those who embarked their capital in the speculation?" In his opinion, the cannel coal gas could not, on account of the expense, come into competition with the Newcastle coal; first, because the residual products from cannel coal would be far less valuable than those derived from the other; and next, because the supply of cannel coal to this neighbourhood must of necessity be limited, and because the price must increase in proportion to the demand for the article. If cannel coal gas should ever come into competition in London, with Newcastle coal, then the whole of the arrangements for gas fittings must be altered. He was quite satisfied that the fittings used for cannel coal gas must be quite different from those used for Newcastle coal gas. The burners especially must be different. The whole regiment of burners must be new. Some makers now talked of their burners as if they supplied more gas than they consumed—as if you had no occasion to buy gas at all, but just to buy the burners, and the gas would come with it. (Laughter.) Again, a much larger amount of capital would be required in works for the manufacture of cannel coal gas, and this would add an intolerable incubus to the already heavy expenditure involved in such undertakings. For these and other reasons he was satisfied that we must look upon cannel coal more as an experiment than as a commercial result. As to its advantoges there could be no question; but he believed its use could never be prevalent in London. It required more attention, as to its use, than Newcastle coal. If cannel coal were used on the butcher's-shop principle, there would be great complaints from the effects of its richness. Many gentlemen could bear him out in saying that certain gas companies produced gas so rich that their customers found fault with it for blackening their ceilings and injuring their paintings by the deposition of certain quantities of carbon.

Having made some observations recommendatory of unanimity among gas-manufacturers, Mr. Gore remarked that the differences that had existed between gas companies and the public were sometimes attributable to the exclusiveness exhibited by the companies, from their love of writing up "no admission except on business," on that wonderful cave of mystery which surrounded every thing connected with gas. That circumstance had tended materially to promote opposition on the part of the public to companies which had obtained monopolies through acts of Parliament. He believed that gas must be a monopoly. The nature of the process required a large outlay of capital, and therefore a large combination of individuals was necessary. But, if monopoly had its advantages, it had its duties; and those men who had a monopoly, and refused to perform the duties incident thereto, deserved all the obloquy and dangers visited upon them. On the other hand, he believed it was not for the interest of the public that such a spirit of wild speculation in gas matters should be encouraged as would cause the expenditure of 2s. where 1s. only would have been sufficient. After thanking the audience for the attention with which he had been heard, Mr. Gore concluded amid loud applause.

On the motion of Mr. Dethridge, a vote of thanks was passed by acclamation to Mr. Gore for his lecture.

Several new members were then elected, and the meeting adjourned.

EXHIBITION FUND.

The committee charged with the management of the proposed exhibition of gas apparatus at the Polytechnic Institution met on Monday, the 3rd inst. Mr. Dethridge in the chair.

Subscriptions to the amount of nearly £400 were announced, including £100 from the Imperial Gas Company, £50 from the Chartered Gas Company, £50 from the London Gas Company, and handsome sums from several other metropolitan and provincial gas companies, as well as from private individuals.

It was unanimously proposed to invite the following gentlemen to become members of the committee, and to co-operate with it in its exertions to render the exhibition worthy of the patronage with which it had been favoured:—Mr. F. J. Evans, superintendent of the Westminster station of the Chartered Gas Company; Mr. Laing, secretary of the Independant Gas Company; Mr. G. Pearse, engineer of the British Gas Company; Mr. Livesey, secretary of the South Metropolitan Gas Company; Mr. Croll, engineer of the Great Central Gas Company; Mr. Wright, manager of the Western Gas Company; Mr. Innes, assistant-engineer of the Phœnix Gas Company; Mr. Christie, superintendent of the Commercial Gas Company; Mr. Stephens, chief inspector of the City Gas Company; and Mr. Gill, secretary to the Ratcliff Gas Company. The other metropolitan gas companies are already represented on the committee.

Mr. Barlow suggested that it would add materially to the interest of the exhibition, and draw a large class of persons who would otherwise not be attracted to it, if a small experimental gas-making apparatus was constructed, in which specimens of coal from all parts of the world could be operated upon, and their values ascertained, as well as experiments made upon the best mode of consuming the several qualities of gas produced by them. Without such an addition, no other gas could be tried except that furnished by the several gas companies supplying the district, and, all these being made from the same material, the investigation would necessarily be limited to the gas made from that material; whereas, if such an apparatus was added, parties might be inclined to bring specimens of coal, not only from all parts of this kingdom, but from foreign countries, and much interest excited by the experiments.

Mr. Andrews and several others highly approved of the suggestion, and Mr. Barlow was requested to obtain further information as to the expense of such an apparatus.

In connection with the above association we have been requested to insert the following notice, and to state that Mr. Strode's name has been erased from the list of the committee in compliance with his request; as also to express their regret that any misunderstanding should have existed as to the reply given by him when it was proposed to place his name on the list:—

"To Gas Companies.—My name having been erroneously printed in a late advertisement as a member of the committee of the Gasfitters' Association Exhibition Fund, I beg to announce that I never was a consenting party to my appointment on that committee.

"William Strode,
"16, St. Martin's-le-Grand."

KNOWLES' ILLUMINATING GAS STOVE.

George Knowles, Esq., *of Wood-end, Scarborough, Proprietor.*
(From the Mechanics' Magazine.)

Fig. 1 is a vertical section, and fig. 2 a horizontal section, of this

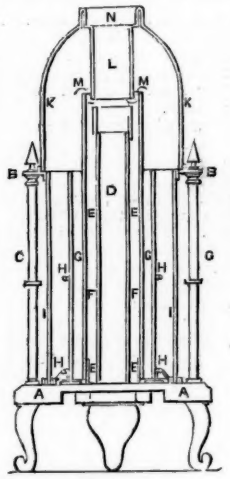

Fig. 1.

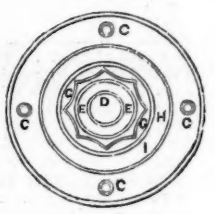

Fig. 2.

stove. The basement, AA, is circular, made of cast iron, and is 17 inches in diameter, which is thought to be the medium size required for ordinary use. This basement stands upon cast feet, about 10 inches from the floor. Within a groove, of the same metal, three quarters of an inch in breadth by half an inch in depth, measuring from centre to centre transversely across the bottom 13 inches, stands a strong glass cylinder, I, 13 inches in diameter and 20 inches high, which is raised on four small pieces of corkwood, affording a space all round for the admission of cold air. At the top of this glass cylinder is a rim, B, of cast metal, which encircles it, and on the upper side of this rim a sand groove is formed, in which stands the dome, K, made of sheet copper, which, being about 16 inches high, makes the whole height of the stove about 3 feet 10 inches. The rim is supported by four cast-iron pillars, CC, three quarters of an inch in diameter, firmly screwed into the bottom of the stove where the feet are placed, and the rim is again screwed down upon the top of the pillars, which gives an adequate degree of firmness to the whole.

In the centre of the bottom is a boss, E′E′, 3 inches high, 5 inches in diameter, and three-eighths of an inch in thickness, to which is attached a staypipe or cylinder, E, 5 inches in diameter within, and rising up in the centre of the stove to the height of 2 feet 6 inches, meeting the funnel of the ventilator in the upper part of the dome. Within the staypipe is another cylinder, D, barely 5 inches in diameter, rising to within an inch in height of the staypipe, in the centre of which is a water cylinder, D, 3 inches in diameter, and of the same height, the space between the two latter being filled with sand. These three cylinders may be made of sheet iron or copper. Surrounding the staypipe is placed the reflector, G, of a round, segmental, or octagonal shape, 7 inches in diameter, and made of sheet copper, silvered on the outside, or of glass, which, on lifting off the dome, K, of the stove, can be taken out and cleaned at pleasure. This reflector is of the same height as the exterior glass cylinder. The gasburners, HH, surround the reflector in two rings, one near the bottom and the other half-way up, 9 inches in diameter, each containing eight burners. One ring only may be used, according to fancy. These rings are connected, and are supplied with gas by means of a pipe introduced at the bottom of the stove, attached to the main. Each ring has its stopcock, so that one or both may be used at pleasure.

Cold air may be supplied, in addition to the provision before described, by means of apertures in the bottom plate of the stove, worked by a sliding valve, like a common ventilator. The waste of water in the water cylinder, by evaporation, may be easily supplied by taking off the dome, the amount of waste being ascertainable by means of a small floating buoy.

This stove affords not only heat but light; and the hot air is tempered and purified by means of the water cylinder, which renders it more fit for respiration than the air of any other stove yet invented. When the stove is used for ordinary purposes, the water in the cylinder is kept below the boiling point—(say, at from 100 deg. to 160 deg. of heat)—by a very simple contrivance. When used in greenhouses, or in places where much moisture may be required, the sand may readily be removed, and the space it occupies filled with water, which may be allowed to rise to any degree of heat.

The stove may be advantageously used in halls, staircases, rooms, offices, places of worship, and other public buildings.

To suit the smaller class of shopkeepers and others where much light is not required, the *dome of the stove only* may be illuminated, which will reduce the first cost of the stove.

GAS COOKING RANGE.

Registered for Mr. Alexander Graham, *Eagle Hotel, Glasgow.*

The economy and cleanliness attending the applications of gas in cooking operations promise to bring about the general introduction of this convenient heating power. Of the various proposed plans of this nature, that of Mr. Graham appears to offer peculiar advantages, as it admits of all the different treatments in use in cooking being carried on simultaneously in one apparatus, and with an economical result hitherto, we believe, unequalled.

Fig. 1 of our engravings represents the range in vertical sectional elevation. Fig. 2 is a corresponding plan.

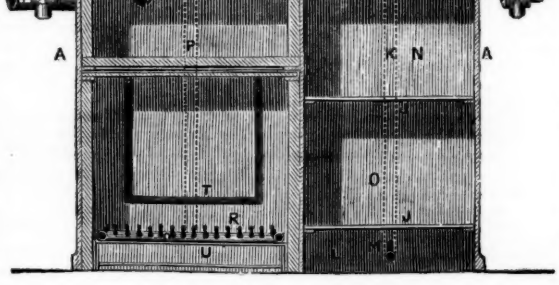

Fig. 1.

It is composed of two cast-iron end plates, A A, with a corresponding back plate of the length of the range, and a top plate, B, the front being covered in by three doors. The gas is led from the main by the pipe, C, from which seven branches are conducted to a corresponding series of burners inside and on the top of the range. The five branches, D, lead to three different sizes of burner scrolls, intended for boiling or heating vessels placed on the top of the range. Each pipe passes close over the top of the range, and the terminal volute, E, rests on the surface. It is studded throughout with small gasburners, F, and is surrounded by a ring of studs, G, standing up from the top of the range. These studs stand up a little higher than the burners, and are connected together by a

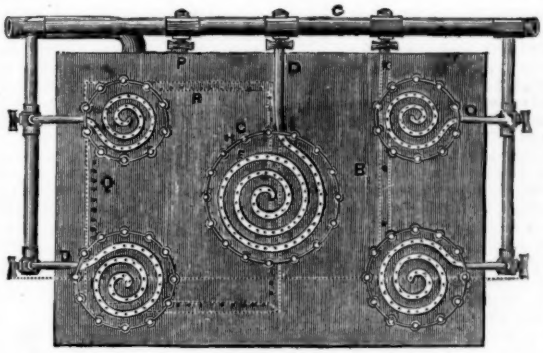

Fig. 2.

flat metal ring, H, which retains the heat from the burners, and guards them from contact with atmospheric currents. The vessel to be heated is placed on the ring of supporting studs corresponding to its size, and the gas flames from the burners are thus brought into close contact with the vessel's bottom. The internal space is divided into two unequal portions by a vertical division plate, I, and the smaller space is again divided into three portions by the moveable slides or shelves, J. A branch, K, from the main gaspipe, C, is bent downwards, and passes into the bottom space, L, terminating in a short horizontal piece carrying the burners, M. The heat from these burners, in its ascent, warms the chambers, N O, which answer as receptacles for plates, or food to be kept hot. A single door closes up this side. The larger division has a branch, P, led into it from the pipe, C. It enters near the bottom, and terminates in the rectangulur burner tube, Q, studded with a series of burners, R, inclined inwards as represented. From the division plate, S, above, a wire frame or netting, T, is suspended to carry the meat to be roasted, the gravy or dripping falling into the bottom receiver, U. The upper division, V, is an oven, which is heated by the same burners, R. The whole of this roasting and baking side of the range is lined with firebrick, W, which collects and radiates the heat from the burners upon the articles being cooked. The bottom of the oven, V, is also lined or covered with firebrick, X, which is heated by radiation from below. The whole of the arrangements of burners are regulated by stopcocks, and each burner is made with a very minute gas aperture, to economize the consumption. The heated air and vapours escape from the oven by the wastepipe, Y.

For this very comprehensive apparatus may be safely claimed the important points of superior economy and cleanliness in action, as well as the more effective preparation of food, and the non-exposure of the cook to the injurious effects of an over-heated atmosphere. A dinner for forty people has been cooked by it with an expenditure of sevenpence worth of gas.

PAINE'S MAGNETO-ELECTRIC MACHINE AND LIGHT.

(*Abridged from the Mechanics' Magazine.*)

SPECIFICATION.

My invention mainly consists in certain improvements in magneto-electric apparatus for decomposing and resolving water and other fluids, and applying the gases evolved therefrom, or elements thereof, to various practical purposes.

In the construction of magneto-electric machines I have made improvements in essential parts, which give the command of greatly-increased power, and admit of the electric force being brought to bear in a novel manner upon the subject to be acted upon. Adhering generally to the ordinary form of the helices, I substitute for the common heliacal coil an insulated coil of hollow wire or tubing of copper or other good-conducting metal, and this hollow wire or tube I fill at pleasure with water or other electrical absorbent. This arrangement has not only the merit of giving a greatly-increased surface (the inner and outer surface of the coils) for the electrical currents, but it also admits of great accumulation, the water or other absorbent taking up the excess during each revolution, and retaining the same till relieved by the action of the dischargers, as after explained.

These tubular coils should be made of some metal that will not easily corrode or oxidate, and must be insulated externally; or they may be made of some non-conducting substance (such as gutta percha), filled with the liquid, and a metallic wire inserted therein. It has been found that electricity when applied in a continuous or unintermitting current cannot be used as a successful agent in decomposing water or other fluid in sufficient quantities, and at a cost that will allow of the application of the products to general purposes; but I have discovered that, when the electric current is made to enter the water in a series of discharges or pulsations, great quantities of gases may be evolved, and at a very moderate cost.

My improvements admit not only of the discharge of the electric

fluid in pulsations, but of its accumulation to any required extent between any two pulsations or discharges.

There are two helices, the interior or cores of which may be of soft iron, or of hollow wire, filled with water; and coils of hollow wire, also filled with water, are wound round the cores, and the ends connected together.

These helices are made to revolve by clockwork, or other simple motive power, between the poles of a pair of permanent magnets, upon one common spindle. On the head of the spindles is an insulated cap with two metallic rings, placed one around its vertical edge, and the other its top, each being insulated from the other; the termini of the heliacal coils are attached one to each ring. (The small rod that connects the discharging rings on the spindle-head with the hollow heliacal coils should be split its entire length, in order that when it enters the hollow coil it may convey the fluid up towards the rings, and allow the electricity to enter the water.) Now, instead of having friction dischargers pressing against these rings, the discharger is made as follows:—A wheel of the required diameter, with its periphery covered with some good non-conducting substance, except at one point (which must be a good conductor), is made to press by means of a spring-arm against the ring on the spindle-head; the stud which supports the spring-arm being insulated, and the conducting wire starting from the arm. By this arrangement no discharge from the helices can take place until the non-insulated point on the discharging-wheel comes in contact with the ring, and consequently, as the diameters of the ring and the wheels are proportionate, so will the amount of accumulations between the discharges be.

The electrodes are constructed upon the principle of conveying the currents on large free conductors terminating in a great number of radial points; the negative pole, or pole-points, radiating from a common centre around and along the conductor's terminus and the positive pole-points converging from the interior of a cylinder or cell, to which the positive conductor is attached; and so *vice versâ*, when the positive pole enters the cell and the negative is attached to its interior. The top of the cell is pierced with numerous small holes, and its bottom with an aperture of about one-sixth its diameter. The conductors should be insulated, so as not to come in contact with the water at any time or place; which may be effected either by passing them through glass tubes, or some non-conducting material, or by coatings of some non-conducting surface. Copper or other metallic cells or cylinders may be used, but the electrodes and the radial and converging points I prefer making of fine platinum. The points on the interior of the cell or cylinder may be dispensed with, and the central or radial points of the electrode be made to come nearly in contact with the cylinder's surface; but practice has proved that this arrangement is not so good as the double points.

[Another arrangement of the electrodes is here described, in which the negative wire of platinum is soldered to one of the conductors, and the end is wound in the form of a spiral, making a cylinder of about one inch long and three-eighths of an inch in diameter, into which coil the positive wire is inserted, the lower end being soldered to a metallic button at the upper end of the negative coil. This arrangement may be reversed when opposite effects are desired.]

In decomposing water, the cell or cylinder, with the electrodes properly arranged and attached, is plunged into a tank or vessel of convenient shape, filled with water. The effect of the arrangement of electrodes, above described, is to isolate as it were a certain quantity of water in the cells or spirals, and to bring to bear upon it, by a series of pulsations or intermittent discharges, the accumulated force of the electric fluid, and thus the gases are evolved with extraordinary rapidity. In experimenting with water I recommend that it be distilled or boiled, in order to get rid of the atmospheric air.

A third modification or form of the electrodes is next shown, in which arrangement the negative pole is attached to the inner side or top of the cell or cylinder. The positive pole passes down into the cell about one-third of its depth, terminating in a plate of copper or other good-conducting metal. From this plate a number of platinum wires or points extend downwards into the centres of a corresponding number of spirals or coils, also of platinum, which are attached to the bottom of the cell. In this arrangement (as well as in the second) the exterior of each coil or spiral must be coated with some non-conducting substance, as well as the exterior of the cell.

A given quantity or force of the electric fluid is required to decompose water, and any excess interferes with its decomposing power, and causes a repulsive action at the electrodes, subjecting them to injurious action. In order to guard against this difficulty, a governor is constructed, as follows:—

The conductors are made to connect with the helices around the electro-magnet, and then pass to the insulated mercurial cylinder. A platinum bar slides into this mercury, and is connected with the end of a balance-beam, which has at its opposite end a similar platinum bar, and a mercurial cylinder, and from the latter proceeds the conductor to the electrodes in the water or other fluid to be decomposed. Attached to the beam, directly over the poles of the electro-magnet, is a keeper or armature. Taking advantage of the well-known law, that the more intense the current passing around the legs of an electro-magnet the greater the power, it is readily perceived that, as all currents passed into the fluid to be decomposed are first made to pass around the electro-magnet, there is consequently a continued force acting on the beam, through the armature, and the action of this force may be easily graduated and governed by placing a spring so as to act on the beam on the opposite side of its fulcrum.

Now, when the beam is so adjusted that, when the proper decomposing action is obtained, the spring balances the power of the magnet, it will be evident that when the action increases the power of the magnet will overcome that of the spring; the beam will be drawn down, and the plantinum bar in the mercury drawn out, and thus break the connection, and keep it broken till the excess has ceased. It has been sometimes found that when the current is suddenly broken, by drawing out the bar in the cylinder, a vacancy or partial vacuum is formed, into which the mercury rises, and is consequently spilled; a result which terminates the action of the machine until the mercury is replaced. In order to avoid this difficulty an auxiliary cylinder is placed under the beam, between the conducting cylinder and the electro-magnets. This cylinder is filled with mercury like the other, and has a platinum bar attached to the beam, which works into it like the other bar. The mercury is gauged in this cylinder, so that the bar shall enter the mercury before the bar leaves its bath, and so turn the current into the cylinder, upon which the current will be conveyed off into the earth or a reservoir of water by means of the conductor.

With respect to hydrogen for the purposes of illumination, I have discovered a means of rendering it highly luminiferous, by passing it through spirits of turpentine and other fluid hydro-carbons. The chief matter to be attended to in this part of the operation is the duration of the passage of the hydrogen, a given time being necessary to the effectual luminiferous or catalyzing process. I therefore employ some mechanical means to retard the passage of the current of gas, and to cause it to bubble through the liquid. The method which I prefer is to attach cotton wick, or the hollow wick of an argand burner, or some such substance, to the end of the tube that descends into the turpentine; or to perforate the end of the tube with numerous small holes.

The passage of the gas in this way divides it into minute globules, and consequently brings a greater amount of surface into contact with the hydro-carbon. I have found that when the pipes which lead from the decomposing tank to the hydro-carbon are made of non-conducting materials, or are coated on their interior with sealing-wax or other insulating substance, the effect is the most brilliant. The hydrogen should, therefore, be conveyed by means of such tubes from the decomposing cells, and passed with all possible speed into the hydro-carbon, after which it may be collected in gasometers or other reservoirs. These latter may also be isolated by position, or by the use of insulating materials; and in practice it may be found highly advantageous to use pipes and tubes of non-conducting materials to convey the gas to the points of consumption. It deserves also to be borne in mind that the vessel containing the turpentine or other hydro-carbon should be of some non-conducting substance, since it appears to be essential to the complete luminiferating or catalyzing of the hydrogen that it should come in contact with the hydro-carbon whilst in a highly electrified state. I would observe also that the height of the column of the hydro-carbon should be nearly equal to that of the column of water around the gasometer, so that the hydrogen shall not pass too rapidly through.

The foregoing description explains a simple and portable form of apparatus, which may be used with or without the governor; but, when larger operations are required, the power may be increased either by the use of large magnets, or by combining the powers of several magnets with a proportionate number of helices. These combinations only require careful mechanical arrangements, directed by practical experience in electric science.

I will now proceed to describe a magneto-electric machine of great power, with which I have experimented very successfully, and which I have called a "Magneto-Electric Decomposer."

By means of a weight, or spring, or other convenient power, I give motion to a train of geared wheels, which, in their turn, cause the helices to revolve between the poles of the magnets. These magnets need not be permanent, but, if not, should be inducted before putting the machine in action. The discharging-wheels being of much larger diameter than the rings on the spindle-head, the helices necessarily revolve several times before a discharge can take place. The electricity is consequently accumulated in the helices, and passes with proportionate intensity at the periodic times. The conducting wires should be of the best-conducting material and of large surface, and in operation upon a large scale. I propose to make them tubular, and, if need be, to fill them with water. The cells and spirals are an important part of the arrangement, and in their construction the condition above mentioned should be well observed. Although I have given this description of the apparatus, I by no means intend to confine myself to any particular form or arrangement. The various purposes for which these machines will be required will render a great variety of sizes necessary; and the nature and principles of the invention will admit of an equal variety of form and modification.

Throughout the foregoing specification water has been spoken of as being decomposed by the electric currents; but I wish it to be understood that this is merely in accordance with generally-received chemical doctrines and phraseology. It may be that water is a simple element; but, whether or not, all I wish at present to lay down as certain is the fact that, by discharging electricity through water in the modes I have described, large quantities of gases are evolved, and that one at least of such gases so evolved, when passed through spirits of turpentine by the means above explained, becomes highly luminiferous.

What I claim is:—

Firstly. The use of helices furnished with hollow heliacal coils or tubes, to be filled at pleasure with water or other electrical absorbent.

Secondly. The construction and use of electrodes, as above described.

Thirdly. The mode of applying electricity to the decomposition of fluids by pulsations or intermittent discharges.

Fourthly. The mode, construction, and use of governors for regulating the electric currents, as described.

Fifthly. The mode of catalyzing or rendering hydrogen gas luminiferous, by passing it through spirits of turpentine or other hydro-carbon at common temperatures.

Sixthly. The use of the non-conducting-pipes and isolated gasometers for conveying and receiving the gases for the purposes of this invention.

POPULAR LECTURES ON CHEMISTRY,

By H. Wyatt, Esq., B.A.

(*Continued from page* 34.)

Carbonic acid is formed under a great number of circumstances. It is the constant product of combustion in our chimneys; it is developed in great quantities in the respiration of animals; all organic matters left to themselves in humid air are destroyed by fermentation, and give off carbonic acid gas in abundance. Active volcanoes also eject this gas into the atmosphere in considerable volumes. Carbonic gas also rises through fissures in many localities which present no igneous eruptions, but which have been of old visited by volcanic convulsions. The waters of springs which rise in the neighbourhood of these fissures contain carbonic acid in solution, and effervesce as they rise to the surface.

Waters resembling these are now prepared by factitious processes. For this purpose ordinary water is saturated with carbonic acid gas, under a strong pressure, and immediately well confined in the bottles or other vessels where it is to be kept.

If this water has been saturated under a pressure of ten atmospheres, it contains a quantity of carbonic acid ten times greater than water which has been saturated at a pressure of only one. A considerable portion of the dissolved gas will then be disengaged when the gaseous water is poured into the glass. If the gas is left to the action of the air, it soon loses its carbonic acid and returns to the state of ordinary water. This circumstance is a natural result of that law of the dissolution of gas in water which was considered at an early stage of these lectures. If we pour the gaseous water into a glass, we see bubbles rise from its sides, and also from the bottom when this is somewhat rough. If we now throw into the glass some body which presents many asperities, as, for instance, a dry crumb of bread, strong effervescence is set up around the morsel. The reason of this phenomenon is as follows:—Each molecule of the carbonic acid in solution is retained by the neighbouring molecules of water, which, in the interior of the liquid, and even at some sensible distance from its sides, are uniformly arranged round the molecule of acid. But, immediately in contact with the side of the glass, the molecule of acid is only retained in solution by the aqueous molecules, which lie on one of its sides, for on the other side the molecules of water are replaced by the vitreous substance of the vessel. But we can understand that the glassy surface may retain the molecule of carbonic acid with much less power than the particles of water whose place it takes. The molecules of water nearest the glass are thus the first to take the gaseous form; but if a certain number of these molecules unite, to form a gaseous bubble, this bubble, in traversing the liquid, will increase in size, by carrying away with it other molecules of carbonic acid gas, in its upward passage. If we conceive for a moment one of these bubbles as arrested in one of its positions, it is clear that the molecules of dissolved carbonic acid which lie on the outside of the bubble are retained by only half the particles of water which retain the molecules of dissolved carbonic acid in the other part of the liquid, and will disengage, therefore, more easily than they.

In localities where carbonic acid gas is disengaged through numerous fissures in the soil, it often happens that gas accumulates in valleys, in natural excavations, and in grottos, where the air is not readily renewed. A stratum of poisonous air is formed, which proves fatal to animals remaining there too long. The famous *Grotte de Chien*, near Naples, presents a phenomenon of this nature. Men may walk in it without danger, while a dog, whose head is so much nearer the ground, falls instantly from asphyxia.

Of late years carbonic acid has been employed to produce a very intense cold, which latter agency has been employed in turn to liquefy, and even solidify, many gaseous substances. But to arrive at this result it is necessary to find the means of producing liquid carbonic acid in great quantity. The apparatus employed for this purpose consists of two portions,—the generator, in which the liquid carbonic acid is formed, and the receiver, into which the liquid acid is then passed, by distillation, so as to separate it from other products of the reaction, and in which are accumulated the products of several successive operations.

Liquid carbonic acid is obtained by decomposing the bicarbonate of soda by means of sulphuric acid in the generator, which is a vessel hermetically sealed. The first portion of disengaged carbonic acid takes the gaseous form; but the pressure soon becomes great enough to liquefy the carbonic acid. The generator was at first made of cast iron, of considerable thickness, but cast iron is a dangerous metal to employ when a great resistance is required: a terrible accident which took place with one of these primitive apparatus proscribed its longer employment. The generator, as now constructed, is made of lead, covered with copper, and encircled with bands of wrought iron. The copper cylinder which encloses the lead fits exactly in all its parts; the two ends are strengthened with plates of iron. The generator is suspended between the two bearings of a cast-iron frame. The construction of the receiver resembles that of the generator; like it, it is formed of lead, and is enclosed in a copper case encircled with iron. Its ends are also formed of iron plates, but it has no narrow neck like the generator. The opening of the generator is closed by a screw stopper, pierced in the line of its axle, and provided with a cock. The screw is worked with a double horizontal wrench-handle. A ring of lead is compressed in a double groove, which lies between the generator and its stopper, and renders the closing hermetical. The receiver, which, unlike the generator, is fixed in an horizontal position, has its opening on its superior side, and near the extremity nearest the generator. Into this opening a tube of copper is inserted, and descends nearly to the bottom of the receiver; it is provided with a cock. Communication between the receiver and generator is established by means of a copper pipe, the two ends of which are fitted to the two apertures just described. In order to set the apparatus in work, we take proper proportions of bicarbonate of soda, water, and concentrated sulphuric acid; the former are introduced into the two generators, the latter is placed in a narrow cylindrical copper vessel, placed on the axle of the generator, so that while it remains vertical no contact can take place between the acid, the bicarbonate, and the water. The stopper is now replaced and closed by its cock. By inclining the suspended generator, so as to make it exceed the horizontal position, the acid contained in the interior copper tubes escapes, and reaction commences. The generator is now made to oscillate a number of times round its own axis, to ensure a certain admixture of its contents. At the expiration of ten minutes the carbonic acid is made to pass into the receiver. For this purpose a communication is established between the generator and receiver; by means of the copper pipe above, the cocks of which are opened, the carbonic acid in the generator immediately distils and condenses anew, in the liquid state, in the receiver. This distillation takes place in virtue of the disparity of the temperature which exists between the receiver and the generator. The temperature of the generator is not lower than 36 degrees; thus, the tension of the carbonic acid it contains is about 75 atmospheres. If the temperature of the receiver be 59 degrees, which we may suppose to be that of the laboratory, the maximum tension of the carbonic acid not being for that temperature more than 50 atmospheres, the distillation will take place in virtue of the difference of pressure, 75, 50, 25 atmospheres; that is to say, it will take place with great rapidity. Under such circumstances one minute will be sufficient to effect the passage of the carbonic acid from the generator to the receiver.

This operation effected, we proceed to a new preparation of carbonic acid, and pass this second portion into the receiver. The receiver is then filled to the extent of two thirds with liquid carbonic acid. If now we open the cock of the receiver it is clear that the liquid carbonic acid will be projected with force out of the vessel. But if this liquid were allowed to dart into the external air it would immediately assume the gaseous form, producing a white cloud in its passage. An intense cold would characterize this gaseous current. If we direct this jet of liquid carbonic acid into a flask, or, better, into a very small metallic box, a great portion of the carbonic acid will volatilize, taking up the heat necessary to this change of state from the walls of the vessel, and from that portion of the carbonic acid which remains liquid; the temperature then falls considerably, the carbonic acid becomes solid, and condenses under the form of a flocculent, of snowy whiteness. Carbonic acid may be preserved under this form longer than in the liquid state. The evaporation of this snowlike acid takes place very slowly, on account of the low conductibility of the substance. A floccule of the snowlike acid may be placed on the hand without causing a very powerful sensation of cold, because the solid acid is constantly isolated from the hand by a current of gaseous acid, which is continually disengaged, and prevents contact; but if the floccule is pressed between the fingers a very painful sensation is felt, like that which is experienced when a hot body is handled, and the skin is disorganized as by a burn.

If we pour upon the snowlike carbonic acid any liquid which does not combine chemically with that acid, and which does not congeal at a very low temperature, the evaporation of the acid will become much more rapid, because the interposed liquid considerably augments the conductibility, and we obtain a refrigerating mixture of great power: ether is commonly employed for this purpose.

Carbonic oxide is prepared by causing a current of carbonic acid gas to pass slowly through a long tube of porcelain, or infusible glass, containing charcoal, and heated to redness. In this case carbonic acid combines with a quantity of carbon equal to that which it already contains.

A more simple process consists in treating finely-powdered carbonate of lime with charcoal in an earthen retort, placed in a reverberatory furnace. The carbonate of lime alone is decomposed at a red heat, disengaging carbonic acid gas, but this gas encounters charcoal at that temperature, and becomes changed into oxide of carbon. It is necessary to agitate the gas collected in the receiver for some time with a small quantity of solution of caustic potash, to absorb a portion of carbonic acid which escapes during the decomposition.

But the most easy method of obtaining carbonic oxide is by decomposing oxalic acid by concentrated sulphuric acid. Oxalic acid, which we shall have to study presently, is a third combination of carbon and oxygen. In its crystalline state it has for its formula—$C^2\,O^3 + 3\,HO$; it is susceptible of losing two equivalents of water easily, and without decomposition; but we cannot remove the third equivalent without decomposing it into carbonic acid and carbonic oxide; we then have the equation $C^2\,O^3 = CO^2 + CO$.

When crystalline oxalic acid is heated with a body having a strong affinity for water—for example, with an excess of concentrated sulphuric acid—this decomposition takes place.

We place oxalic acid in a small flask, and add five or six times its weight of concentrated sulphuric acid. We then adapt to the flask an abducting tube, which leads the gas into a bell glass, placed over water or mercury. As heat is applied, the oxalic acid dissolves at first in sulphuric acid, but presently an effervescence is seen, which arises from the decomposition of the oxalic acid into its two gaseous products. Carbonic acid gas and carbonic oxide are disengaged in equal volumes; the mixture is collected in a receiver, the carbonic acid gas is absorbed by means of a solution of potash, and the oxide of carbon remains pure. To accomplish the separation of the two gases, we may pass the mixture through a lavatory flask, containing a solution of potash only; a small portion of carbonic acid gas will then remain to be absorbed, by a solution of potash, in the receiving jar.

Carbonic oxide is a colourless, inodorous gas; it has not yet been liquefied. It burns in the air with a characteristic bluish flame, and then changes into carbonic acid. Its density is 0·967. Water dissolves about 1-16th of its volume. It exerts no reaction on litmus; and combines with neither acids or bases.

Whenever charcoal is burned in our furnaces, without the access of a sufficient quantity of oxygen, very much carbonic oxide is formed—

(*Continued on last page but one.*)

Share List.

THE PRICES QUOTED ARE THOSE AT WHICH THE LAST SALES HAVE BEEN MADE.

The Companies whose names are printed in italic type are incorporated by Act of Parliament.

Number of Shares issued.	Amount per Share	Name of Company.	Amount paid up per Share	Dividend per Cent. per Ann.	Price.
	£	**ENGLAND.**	£ s. d	£ s. d	£ s. d
		Aberdare			
		Aberystwith			
		Abingdon			
		Accrington £7000		5 0 0	
		Alcester			
		Alford, Lincolnsh.			
		Alfreton			
		Alnwick			
		Alston Moor			
250	10	Alton	10 0 0	5 0 0	10 0 0
800	5	Altrincham	5 0 0	4 0 0	
		Amlwch			
160	10	Ampthill	10 0 0	5 0 0	10 0 0
350	10	Andover	10 0 0	6 0 0	11 0 0
		Appleby			
		Arundel			
		Ashbourn, Derby			
		Ashburton			
		Ashby-de-la-Zouch			
		Ashford, Kent			
		Ashton-under-Line £39,700		10 0 0	
		Atherstone			
		Axminster			
225	20	Aylesbury	20 0 0	5 0 0	21 0 0
		Aylsham, Norfolk			
		Bacup, Yorkshire			
		Bakewell			
		Baldock			
140	25	Banbury	25 0 0		
		Bangor			
500	5	Barking, Essex	4 10 0	5 11 0	5 0 0
250	10	Barnard Castle	10 0 0	5 10 0	10 15 0
		Barnet			
		Barnsley £6000		7 10 0	
100	20	Barnstaple	20 0 0	7 10 0	25 0 0
		Barton			
120	25	Basingstoke	25 0 0	8 0 0	28 0 0
2400	20	*Bath*	16 0 0	6 0 0	25 to 30
		Battle £2000		6 0 0	
56	26½	Bawtry	26 10 0	5 0 0	25 0 0
		Beaumaris			
		Beccles, Bungay, and Lowestoft			
		Bedford			
		Bedworth			
		Belford			
		Bedale, Yorkshire			
		Belper			
		Bemimster			
		Berkhampstead			
700	5½	Berwick-on-Tweed	5 10 0	6 8 0	5 15 0
		Beverley			
		Bewdley			
980	10	Bideford	10 0 0	6 0 0	10 10 0
		Biggleswade			
160	10	Bicester	10 0 0	5 0 0	10 0 0
		Bilston £15,100		6 10 0	
		Billericay			
		Bingley £7400		4 0 0	
		Birkenhead and Claughton £70,000	35 0 0	3 0 0	32 to 34
2400	50	*Birmingham and Staffordshire*	50 0 0	8 0 0	90 to 91
	25	*Ditto*, new shares	7 10 0	8 0 0	12 0 0
704	75	*Birmingham*	75 0 0	9 0 0	128 to 130
		Bishop's Auckland			
		Bishop's Stortford			
		Blackburn £30,000		10 0 0	
		Blandford			
		Blythe			
		Bodmin			
		Bognor			
		Bolton £38,582		9 19 5	
		Boroughbridge			
		Boston £8000		10 0 0	
200	10	Bourn	10 0 0	5 0 0	
		Brackley			
		Bradford, Wilts			
		Bradford, Yorksh. £45,000		9 10 0	
		Brampton, Cumb.			
		Brandon, Suffolk			
		Brecon			
		Bridge-end, Glam.			
		Brierly Hill			
2250	20	*Brighton*	20 0 0	5 0 0	14 to 15
1125	20	„ new shares	16 0 0	5 0 0	
		Brighton and Hove £50,276			
4250	20	*Bristol*	20 0 0	9 0 0	37 0 0
1725	25	*Bristol and Clifton*	25 0 0	6 0 0	25 0 0
		Brixham			
		Braintree			
750	50	*Brentford*	50 0 0	6 0 0	44 to 46
800	25	„ new shares	11 0 0	6 0 0	11 0 0
		Brentwood			
		Bridgwater £6000		5 0 0	
400	10	Bridlington	10 0 0	5 0 0	10 0 0
		Bridport			
		Brigg			
100	50	Bromley, Kent	50 0 0	6 0 0	52 10 0
		Bromsgrove			
		Broughton			
120	10	Bruton	10 0 0	4 0 0	8 0 0
100	25	Buckingham	25 0 0	5 0 0	25 0 0
		Bungay (see Beccles)			
		Burford			
		Burnley £19,946		4 10 2	
		Bursiem			
		Burton-on-Trent			
		Bury St. Edmund's £10,500		5 0 0	
		Bury, Lanc. £6570			
		Buxton			
		Callington			
		Calne, Wilts			
		Camborne			
		Cambridge £34,560		9 0 0	
240	50	*Canterbury* Gas and Water	50 0 0	6 0 0	57 to 58
240	25	*Ditto*, second issue	25 0 0	6 0 0	28 to 29
		Cardiff £12,000		7 10 0	
		Carmarthen			
		Chapel on the Frith			
		Chard			
		Chatham (see Rochester)			
		Chatteris			
		Cheadle			
		Chelmsford			
		Cheltenham £18,732		8 10 0	
		Chepstow			
		Chertsey			
230	10	Chesham, Bucks	10 0 0		
		Chester			
		Chester-le-Street			
		Chesterfield £13,123		4 17 6	
240	25	Chichester	25 0 0	6 0 0	30 0 0
		Chippenham			
		Chipping Norton			
		Chirk			
		Chorley			
		Chudleigh			
		Cirencester			
		Clifton (Bristol and Clifton)			
		Cleckheaton, York.			
		Clitheroe			
		Cockermouth			
		Colchester			
		Collumpton			
		Colne, Lancashire			
		Coleford, Gloucest.			
		Coggeshall			
		Congleton £5000		5 0 0	
		Cowbridge			
800	25	*Coventry*	25 0 0	6 0 0	20 0 0
		Cowes			
		Crewkerne			
		Croydon ... £30,000		5 0 0	
		Cranbrook ... £1900		5 0 0	
		Crediton			
		Crewe, Cheshire			
		Cricklade			
		Darlaston			
		Darlington			
250	20	Dartford	20 0 0	7 10 0	27 0 0
		Dartmouth			
125	20	Daventry	20 0 0	6 0 0	24 8 0
		Dawley, Shrop.			
		Dawlish			
500	6	Denbigh	6 0 0	5 0 0	6 0 0
820	10	Deptford	10 0 0	5 0 0	4 10 0
325	50	*Derby*	50 0 0	10 0 0	
90	20	Dereham (East)	20 0 0	4 10 0	
100	5	*Dewsbury*	5 0 0	10 0 0	8 12 6
		Devizes			
4000	5	*Devonport*	5 0 0	6 0 0	6 5 0
		Doncaster			
280	25	Dorchester	25 0 0	5 0 0	30 0 0
120	25	Dorking	20 10 0	5 0 0	21 10 0
		Douglas, Isle of M.			
209	56½	*Dover*	56 10 0	4 15 4	55 0 0
		Downham			
		Driffield			
		Droitwich			
600	20	*Dudley*	20 0 0	4 0 0	15 to 16
		Dunmow			
		Dunstable			
		Durham			
276	9	Dursley, Gloster	9 0 0	5 10 0	8 0 0
		East Grinstead			
		Elland			
		Ellesmere			
		Enfield			
300	19	Epsom and Ewell	19 0 0		
		Evesham			
		Exeter £40,000		10 0 0	
		Exmouth			
		Eye, Suffolk			
64	25	Fakenham	25 0 0	5 0 0	25 0 0
		Falmouth			
		Fareham			
120	25	Farnham	25 0 0	10 0 0	42 0 0
		Farringdon			
		Faversham			
		Ferrybridge			
		Fleetwood			
		Folkestone			
		Fowey			
240	5	Framlingham	3 10 0		
		Frome			
		Garstang			
		Gillingham, Dorset			
		Glastonbury			
		Glossop ... £10,000		9 0 0	
		Gloucester £25,000		7 10 0	
		Gomersal			
		Godalming			
		Gosport			
		Grantham			
1000	20	Gravesend	20 0 0	5 0 0	21 0 0
1000	10	*Great Grimsby*	8 0 0	8 0 0	10½ to 11
	25	Guildford	25 0 0	4 0 0	20 0 0
		Guisborough			
		Hadleigh			
		Hales Owen			
300	6	Halesworth	6 0 0	7 10 0	5 10 0
		Halifax £15,000		10 0 0	
		Halstead			
		Hampton Court			
		Harrogate £10,000		5 0 0	
		Hartlepool £15,137		7 10 0	
		Haslingden, Lansh.			
330	50	Hastings and St. Leonard's	50 0 0	6 0 0	60 0 0
		Haverfordwest			
		Haverhill			
		Haworth, Yorks.			
		Hayle			
		Helstone			
		Hemel Hempstead			
300	10	Henley-on-Thams.	10 0 0		
		Hereford £5300		4 0 0	
		Herne Bay			
270	10	Hexham	10 0 0	7 0 0	12 0 0
		Heywood £10,000		5 0 0	
		Highworth (Wilts)			
230	10	Hinckley	10 0 0	5 0 0	7 0 0
		Hindley, Lancash.			
		Hitchen			
		Hythe			
		Hoddesden			
		Holbeach			
		Holmfirth £8880		3 10 0	
		Holyhead			
		Holywell (see British Provincial)			
		Honiton			
		Horncastle			
10		Houghton-le-Sprg.	10 0 0	8 0 0	
		Horsham			
		Howden			
		Hull, Sculcoats (see British Provin.)			
		Hull, £11,712. 10s.		5 0 0	
210	10	Hungerford	10 0 0	5 0 0	10 0 0
		Huddersfield			
520	5	High Wycombe	5 0 0		5 0 0
		Ilminster			
		Ilford			
		Ilfracombe			
		Ironbridge			
1400	10	*Ipswich*	10 0 0	8 0 0	15 0 0
1400	10	„ new shares	5 0 0	8 0 0	
800	25	*Isle of Thanet* (Ramsgate&Mar.)	20 0 0	5 0 0	20 to 21
		Kendal £9100		8 15 0	
		Kenilworth			
		Keswick			
		Kettering	25 0 0	5 0 0	25 0 0
100	25	*Kiddermins.* £10000		5 0 0	
		King's Langley			
		Kington, Hereford			
		Kirkby Lonsdale			
		Kirkham, nr. Preston			
		Knutsford			
		Lancaster			
		Llanelly £3000		5 0 0	
		Llandovery			
		Leamington Priors £22,500		6 0 0	
		Leatherhead			
		Ledbury			
		Leeds Old Comp. old stk., £60,300		10 0 0	
		new „ £23,775		6 0 0	
		Leeds New £60,000		10 0 0	
		Leek			
		Leicester ... £36,230		7 0 0	
		Leigh			
125	20	Leighton Buzzard	20 0	5 0 0	
		Leominster			
		Leyburn, Yorksh.			
		Liskeard			
330	25	Lewes	25 0 0	5 0 0	23 0 0
		Lincoln £8000		10 0 0	
		Leyland, Lancash.			
		Littlehampton			
250	20	Lichfield	20 0 0	7 10 0	27 10 0
		Liverpool United	100 0 0	9 0 0	174 to 176
		„ ¼ sh.	25 0 0	9 0 0	43¼ to 43¾
		Langport			
		London Comps.—			
5000	40	*British*	18 0 0	5 0 0	12 to 13
		„ debentures £46,300		4 0 0	
5000	20	„ Provincial—(Gloucester, Holywell, Hull, Norwich, Stoke, Trowbridg)	20 0 0	7 0 0	16 to 18
	20	„ Prov., new	8 0 0	7 0 0	5 to 7
	25	*Commercial*	25 0 0	6 0 0	23½ to 24½
	25	„ new shares	15 0 0	6 0 0	par to 1dis
	25	„ „	2 10 0	6 0 0	par to 1dis
12,000	50	*Chartered*	50 0 0	6 0 0	45 to 47
6000	50	„ new shares	10 0 0	6 0 0	9 to 9½
2000	150	*City of London*	150 0 0	5 0 0	140 to 150
4000	50	*Equitable*	50 0 0	2 10 0	29 to 30
		„ debentures £46,000			
10,000	20	European—(Amiens, Boulogne, Caen, Havre, Nantes, and Rouen)	20 0 0	5 0 0	10 to 12
	20	„ do. new	5 10 0	5 0 0	3½ to 4

Number of Shares issued.	Amount per Share	Name of Company.	Amount paid up per Share	Dividend per Cent. per Ann.	Price.
	£		£ s. d	£ s. d	£ s. d
15,000	10	Gt.Cntl.Consumers	10 0 0		
8000	50	*Impl.Continental*—(Amsterdam, Aix-la-Chapelle Antwerp, Berlin, Bordeaux, Brussels, Cologne, Frankft., Ghent, Haarlem Hanover, Lille, Marseilles, Rotterdam, Toulouse, Vienna)	42 0 0		40 to 45
7000	50	„ new shares	41 0 0		50 to 55
	50	„ third issue	42 10 0		40 to 45
10,000	50	*Imperial*	50 0 0	6 0 0	69 to 71
3000	50	„ new shares	35 0 0	6 0 0	50 to 52
		„ debentures £50,500			
4000	40	*Independent*	10 0 0	6 0 0	45 to 47
3000	50	*London*	50 0 0		7 to 9
6000	25	„ preference	7 10 0	6 0 0	7¼
3000	50	„ 2nd do.	50 0 0		18 to 20
9000	50	*Phœnix*	49 0 0	4 10 0	27 to 29
1600	100	*Ratcliff*	90 0 0	5 0 0	58 to 60
4000	25	*South Metrop.*	25 0 0	6 0 0	23¼ to 24¼
9000	50	UnitedGeneral—(Cork, Dublin, Limerick)	50 0 0	2 0 0	15 to 15½
12,500	20	Western	18 0 0		7 0 0
		Lostwithiel			
		Loughborough			
240	25	*Louth*	25 0 0	6 0 0	26 10 0
		Lowestoft (see Beccles)			
611	5	Ludlow Union	5 0 0	6 0 0	5 0 0
		Luton			
		Lutterworth			
		Lyme Regis			
		Lymington			
		Malmesbury			
		Macclesfield 32,000		3 15 0	
		Maidenhead			
300	50	*Maidstone*	50 0 0	10 0 0	90 0 0
		Maldon			
		Marlborough			
		Malton (New)			
		Malvern			
		Manningtree			
		Mansfield £5000		10 0 0	
		March			
		Margate (see I. of T.			
		Market Deeping			
		Market Drayton			
132	25	Market Harboro'	25 0 0	6 0 0	30 0 0
		Market Raisin			
		Market Weighton			
		Marlow			
370	10	Maryport	10 0 0	6 0 0	12 0 0
		Melksham			
		Melton Mowbray			
		Merthyr Tydvil			
		Mere			
		Middleton £9032		5 0 0	
		MidsummerNorton			
		Middlesboro'			
		Mildenhall			
		Mitcham			
		Mold			
700	10	Monmouth Gas and Water	10 0 0	5 0 0	
		Monk Wearmouth			
		Moreton in Marsh			
		Morley			
		Mottram			
		Nantwich			
		Neath			
		Needham Market			
		Newark	£5000	10 0 0	
250	20	Newbury	20 0 0	5 0 0	20 0 0
13,000	5	Newcastle & Gateshead Union	5 0 0	8 0 0	6 12 6
		Newcastle-under-Lyme	£6200	4 0 0	
600	5	Newmarket	5 0 0	6 0 0	5 0 0
		Newnham, Glost.			
		Newent			
		New Mills & Hayfield	£2115		
		Newport, M.	£11720	8 0 0	
320	50	*Newport, Isle of W.*	38 0 0	4 0 0	19 to 20
		Newport Pagnell			
		Newport, Salop			
		Newton Abbot			
		Newton, Lanc.			
		Northallerton			
		North Walsham			
542	20	*Northampton*	18 0 0	10 0 8	27 0 0
		Northwich			
		Norwich (see British Pro.	£40,000	7 0 0	
900	50	*Nottingham*	50 0 0	10 0 0	
900	50	New shares		10 0 0	
		Nuneaton			
		Oakham			
		Oakhampton			
200	10	Odiham, Hants	10 0 0	3 10 0	10 0 0
		Oldham			
		Ongar			
		Ormskirk			
		Otley, Yorkshire			
		Oundle			
		Oxford	£18,000	9 10 0	
		Over Darwen	£8000	5 0 0	
		Padstow			
		Pately Bridge, Yrk.			
250	20	Penrith	15 0 0	6 10 0	21 0 0
		Penryn			
		Penzance			
200	10	Petworth	10 0 0	9 10 0	12 0 0
		Pickering			
3000	10	*Plymouth & Stonehouse*	10 0 0	6 0 0	11 0 0

Number of Shares issued.	Amount per Share	Name of Company.	Amount paid up per Share	Dividend per Cent. per Ann.	Price.
	£		£ s. d	£ s. d	£ s. d
		Pocklington			
		Pontefract			
		Pontypridd			
400	10	Poole	10 0 0	5 0 0	10 0 0
		Port Madoc			
600	50	*Portsea Island*	53 0 0	5 0 0	45 to 47
400	10	Prescott	9 0 0	4 13 4	7 0 0
		Preston £52,500		10 0 0	
		Pwllheli			
		Pudsey £12,000		5 0 0	
		Radcliff and Pilkington £9000		4 12 10	
		Ramsay, I. of Man			
		Ramsgate (see Isle of Thanet)			
		Ravenglass			
1000	10	*Reading*	10 0 0	3 0 0	7 0 0
500	20	*Reading Union*	20 0 0	6 0 0	17 0 0
		Redditch			
		Redruth			
		Reigate			
		Retford (East)			
		Rhyl			
		Richmond (Surrey)			
		Ripon			
		Rochester and Chatham £20,000		6 0 0	
		Rochford			
		Rockingham			
		Romford			
		Ross			
245	25	*Rotherham*	25 0 0	6 0 0	40 10 0
		Royston			
		Ruabon			
		Rugby			
		Rugeley			
		Runcorn £11,000		7 10 0	
500	10	Ryde	10 0 0	6 0 0	12 0 0
		Rye			
		Romsey			
		Saddleworth			
225	20	Saffron Walden	20 0 0	3 15 0	19 0 0
		St. Austel			
		St. Asaph			
		St. Colomb			
		St. Helen's £7500		7 10 0	
		St. Helier's (Jersey)			
		St. Ives, Hunting.			
		St. Ives, Cornwall			
250	10	St. Neot's	10 0 0	8 0 0	12 0 0
		St. Peter's Port, (Guernsey)			
320	25	Salisbury	25 0 0	6 0 0	28 to 30
		Sandbach			
140	10	Saxmundham	10 0 0	5 0 0	10 0 0
		Scarborough			
		Seaham Harbour			
		Selby			
		Settle			
290	10	Sevenoaks	10 0 0	5 0 0	10 0 0
		Shaftesbury			
5400	25	*Sheffield United*	24 0 0	8 6 8	35 0 0
		Shelton, Potteries (see Brit. Prov.)			
		Shepton Mallet			
		Sherborne			
2914	5	Shields, North (Tynemouth)	5 0 0	3 0 0	5 0 0
		Shields (South)			
		Shiffnal, Salop			
1000	5	*Shipley*	5 0 0	6 0 0	5 12 6
		Shipston-on-Stour			
		Shoreham			
		Shrewsbury	£10,000	7 0 0	
400	10	Skipton	10 0 0	4 0 0	11 0 0
250	10	Sleaford	10 0 0		
		Slough			
		Snaith			
		Soham			
		Southwold			
1000	50	South Molton			
		Southampton	32 0 0	5 0 0	
		Sowerby, Yorksh.			
		Stretford			
		Stokesley			
		Stafford £10,000		5 0 0	
		Staines and Egham			
		Staley Bridge £15,000		10 0 0	
		Stamford £11,250		3 0 0	
		Stockton-on-Tees £7980		9 5 0	
840	9½	Stockton, New	9 10 0	9 0 0	8 0 0
960	10	Stoke-upon-Trent	10 0 0	5 10 0	10 0 0
500	10	„ new shares	4 0 0	5 10 0	10 0 0
		Stone, Stafford			
		Stoney Stratford			
		Stourbridge			
		Stowmarket			
150	20	Stratford-on-Avon	20 0 0	7 10 0	30 0 0
		Stroud			
169	10	Swaffham	10 0 0	5 0 0	5 10 0
		Swansea £9000			
		Sudbury			
		Sunderland, old			
6400	5	*Sunderland*, new	5 0 0		
		Sutton			
		Swindon			
2800	5	*Taunton*	5 0 0	None	2 10 0
		Tadcaster			
		Tamworth			
		Tavistock			
		Teignmouth			
		Tenbury			
		Tenby			
		Tenterden £2000		2 10 0	
		Tetbury, Gloster			
		Tewkesbury			
		Thame			
		Thetford			
		Thirsk			
		Thornbury			

Number of Shares issued.	Amount per Share	Name of Company.	Amount paid up per Share	Dividend per Cent. per Ann.	Price.
	£		£ s. d	£ s. d	£ s. d
		Thorne			
		Tiverton			
670	5	Todmorden	3 0 6		
		Torquay			
		Torrington, Devon			
		Totnes			
		Totnes and Bridgetown Consumers			
4000	5	Tottenham	3 10 0	6 0 0	3 0 0
		Towcester			
		Tring			
		Trowbridge (see British Provin.)			
75	50	Truro	50 0 0	2 0 0	
		Tunbridge			
		Tunbridge Wells			
		Ulverston			
		Uppingham			
240	5	Upton-on-Severn	5 0 0	5 0 0	5 0 0
		Usk, Monmouth			
		Uttoxeter			
		Uxbridge			
1000	25	*Wakefield*, old capl	25 0 0	6 0 0	25 0 0
1600	5	„ new „	5 0 0	6 0 0	5 0 0
300	10	Wallingford	10 0 0	5 0 0	8 0 0
		Wandsworth			
		Wantage			
		Warrington £23304		10 0 0	
100	10	Wareham	10 0 0	3 10 0	8 0 0
120	25	Warminster	25 0 0	5 0 0	27 0 0
		Warth			
		Warwick £15,000		6 0 0	
		Watford			
		Welchpool, Mntgy.			
		Wellingborough			
		Wellington, Salop			
		Wellington, Smrst.			
		Wells, Smrst. £5000		7 10 0	
		Westbury			
		Weston-sup.-Mare			
2000	5	West Ham	5 0 0	6 0 0	5 0 0
		Whitby			
		Whitehaven			
		Whitstable			
		Whittlesea			
		Wigan £10,160		12 10 0	
		Willenhall			
		Winchelsea			
		Winslow			
240	10	Wimborne Minster	10 0 0		
		Wincanton			
360	50	Winchester	50 0 0	6 0 0	
900	12½	Windsor	12 10 0	10 0 0	23 0 0
		Witham			
		Witney			
4448	10	*Wolverhampton*	10 0 0	7 0 0	15 0 0
		Woburn			
210	10	Wokingham	10 0 0		10 0 0
		Woodbridge			
		Wooler			
		Wotton-un.-Edge			
		Worcester £29,000		8 0 0	
		Workington			
		Worksop and Radford			
		Wirksworth			
		Worthing			
		Wrexham			
		Woolwich			
		Woolwich Consms.			
		Woolwich (North)			
		Wymondham			
		Yarm			
795	20	Yarmouth	20 0 0		15½ to 16½
		Yeadon, near Leeds			
		Yeovil			
		York Untd. £55,000		7 0 0	
		SCOTLAND.			
		Aberdeen			
		Airdrie			
		Ailos			
		Annan			
		Anstruther			
		Ardrossan			
550	20	Arbroath	20 0 0	7 10 0	7 10 0
		Auchterarder			
750	2	Auchtermuchty	2 0 0	6 0 0	2 10 0
		Ayr, old			
		Ditto, new			
		Banff			
		Barrhead			
		Bathgate			
		Beith			
		Bervie			
		Biggar			
		Blairgowrie			
300	6	Borrowstowness	6 0 0	5 0 0	8 0 0
		Brechin			
		Bridge of Allan			
		Broughty Ferry			
		Burntisland			
		Callen			
		Campbelton			
		Clackmannan			
		Coatbridge			
		Coldstream			
		Collinsburgh			
		Crieff			
		Crail, Fife			
		Cumbernauld			
		Cumnock			
600	5	Cupar Angus	5 0 0	6 0 0	5 10 0
250	10	Cupar Fife	10 0 0	7 10 0	14 0 0
		Dalkeith			
		Dingwall			
		Dornoch			
		Douglas			
		Dumbarton			
400	20	Dumfries	14 0 0	5 0 0	20 0 0
		Dunbar			
		Dunblane			
		Dundee, old £29,687		4 4 0	

Number of Shares issued.	Amount per Share	Name of Company.	Amount paid up per Share	Dividend per Cent. per Ann.	Price.
	£		£ s. d	£ s. d	£ s. d
		Dundee, nw £33,851		2 10 0	
860	10	Dunfermline	10 0 0	6 0 0	12 12 0
		Dunkeld			
		Dunse			
		Dysart			
6000	25	*Edinburgh Gas Co.*	25 0 0	10 0 0	45 0 0
		„ *and Leith Co.* £98,640		6 10 0	
		Elie			
		Elgin			
		Falkirk, old			
		„ new			
		Falkland			
		Ferry Port on Craig			
		Fochabers			
		Forfar			
		Fort William			
		Fraserburgh			
		Galashiels			
		Garlieston			
		Gatehouse n. Fleet			
		Girvan			
		Glasgow £122,500		7 10 0	
15000	10	*Glasgow City and Suburban*	9 0 0	6 10 0	9 0 0
		Grangemouth			
		Grahamston			
		Haddington			
		Hamilton £7500		8 0 0	
		Hawick			
		Helensburgh			
		Huntly			
		Inverary			
400	1	Inverkeithing	1 0 0	5 0 0	1 0 0
1200	10	*Inverness Gas and Water*	10 0 0	5 10 0	15 0 0
2400	5	„ new shares	1 5 0	5 10 0	2 5 0
		Irvine			
		Jedburgh			
		Johnstone, near Paisley			
		Keith			
		Kelso			
		Kilmarnock			
		Kincardine			
		Kinghorn			
		Kingskittlo, Fife			
		Kinross			
		Kirkaldy			
320	5	Kirkcudbright	5 0 0	5 0 0	5 0 0
1000	3	Kirkintulloch, near Glasgow	3 0 0	5 0 0	3 0 0
227	5	Kirkwall	5 0 0	5 0 0	4 10 0
518	5	Kirriemuir	5 0 0	6 0 0	
		Lanark			
		Largo, near Leven			
		Largs			
		Lasswade, n. Edin.			
		Lauder			
		Leith			
		Leslie, Fife			
		Lesmahago			
		Leven			
		Linlithgow			
		Linton, n. Nobleh.			
		Lochee, n. Dundee			
		Lochgilphead			
		Lochwinnock, near Paisley			
1200	1	Markinch	1 0 0	7 10 0	1 5 0
		Mauchline			
		Maxwell-town, n. Dumfries			
		Maybole, Ayrshire			
		Maryhill, near Glasgow			
		Melrose			
718	2	Mid & East Calder	2 0 0		2 0 0
192	5	Moffat	5 0 0		
13½		Montrose	13 10 0	7 11 1	
		Musselburgh			
		Nairn			
		Neilston, n. Glasg.			
		Newmills, near Kilmarnock			
		Newburgh, Fife			
		Newton Stewart			
		North Berwick, n. Haddington			
		North Queensferry			
		Oban			
		Peebles			
800	25	Perth	25 0 0	4 16 0	22 10 0
		Peterhead			
		Pittenweem			
		Pollokshaws, near Glasgow			
		Port Glasgow			
		Portobello, near Edinburgh			
		Prestonpans			
		Rutherglen, near Glasgow			
		Renfrew, n. Paisley			
		Saltcoats			
		Sanquhar			
		Selkirk			
		South Queensferry			
		St. Andrew's			
		Stewarton			
		Stirling			
		Stoneheavn			
		Stonhouse, Lanrks.			
		Stornoway			
		Stranraer			
		Strathaven, near Hamilton			
		Thurso			
		Tillicoultry, n. Alloa			
800	1	Tranent	1 0 0		1 0 0
		Troon			
		Wick			
		Wigton			
		Wemyss	4 10 0		
		IRELAND.			
300	10	Armagh	10 0 0	8 0 0	14 10 0
		Ballinasloe			
700	50	*Belfast*	50 0 0		
		Ballymena			
		Ballymoney			
		Carrick-on-Suir			
		Carrickfergus			
		Carlow, new			
		Cork (see Un. Gen.)			
		Clonmel Consumrs			
		Drogheda			
19,000	10	*Dublin Consumers*	5 0 0	7 0 0	6 0 0
		Dublin Hibernian (see United Gen.)			
160	25	Dundalk	25 0 0		22 0 0
		Dungannon			
1000	5	*Downpatrick*	5 0 0		
		Enniskillen			
		Galway			
400	10	Kilkenny	10 0 0	8 0 0	11 5 0
		Larne			
		Limerick (see U.G.)			
1725	5	Limerick Consum.	5 0 0	5 0 0	5 0 0
600	15	Londonderry	15 0 0	6 13 4	21 10 0
500	7	Lisburn	7 0 0	6 5 0	7 0 0
520	10	Lurgan	6 0 0	6 0 0	6 0 0
		Mallow			
		Monaghan			
		Nenagh			
418	5	Newtownards	5 0 0	4 0 0	5 0 0
		New Ross			
		Newry			
		Omagh			
125	20	Portadown	20 0 0	6 0 0	20 0 0
600	10	Sligo	10 0 0		
		Tipperary			
		Tralee			
		Waterford			
		Wexford			

The Gas Works in the undermentioned towns belong to private individuals:—

Abergavenny.	Ely.	Hertford.	Morpeth.	Sheerness.	Ware. (2 works)
Bridgenorth.	Farsley.	Holt.	Oswestry.	Sidmouth.	Wem.
Carlow, old.	Gainsborough.	Huntingdon.	Peterborough.	Sittingbourne.	Weymouth.
Carnarvon.	Goole.	Hyde (Cheshire)	Pontypool.	Spalding.	Whitchurch (Salop).
Deal.	Harleston.	Kingston-on-Thames.	St. Alban's.	Waltham Abbey.	Wisbeach.
Diss.	Hatfield.	Lynn.	Sandwich.		

The Gas Works belong to the Corporations, or to Commissioners acting under special acts of Parliament, in the following towns:—

Carlisle.	Keighly.	Milton (Kent).	Richmond (Yorkshire).	Southport (Lanc.)	Walsall.
Cashel.	Knaresborough.	Paisley.	Ruthin.	Stockport	Wells (Norfolk).
Coleraine.	Lytham (Lanc.)	Rochdale.	Salford.	Strabane.	Youghall.
Greenock.	Manchester.	Rothesay.			

Price Current.

The following List of Prices is corrected by an eminent wholesale house in each trade up to the latest period:—

CASTINGS, per Ton.
Average Weight of Cast Iron Pipes, per Yard.

1½ in.	2 in.	2½ in.	3 in.	4 in.	5 in.	6 in.	7 in.	8 in.	9 in.	10 in.	12 in.
16	21	28	33	51	70	89	107	126	149	177	208 lbs.

Retail Prices are 5 to 10 per cent. higher.	London.	Glasgow	Newcastle.	Wales.	Yorksh., Derbysh., and Staffrdsh
	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
Pig Iron, No. 1	3 7 6	2 10 0	3 0 0	3 15 0	3 10 0
1¼ and 2 inches Socket Pipes	6 0 0	5 0 0	5 10 0	5 15 0	5 15 0
2½ and 3 do. do.	5 17 6	4 17 6	5 7 6	5 12 6	5 12 6
4 and 5 do. do.	5 15 0	4 15 0	5 5 0	5 10 0	5 10 0
6 inches and upwards do.	5 12 6	4 15 0	5 2 6	5 7 6	5 7 6
Extra for bends, branches, and connection	2 0 0	2 0 0	2 0 0	2 0 0	2 0 0
Retorts, 1st fusion	5 5 0	..	..	4 17 6	5 0 0
Do. 2nd fusion	5 15 0	4 10 0	4 17 6	5 5 0	5 5 0
Tank Plates, ⅜ thick and above	5 10 0	4 17 6	5 0 0	5 7 6	5 17 6
Do. less than ⅜	5 15 0	5 0 0	5 0 0	..	5 10 0
Plain Castings ex. models	5 15 0	5 0 0	5 0 0	5 10 0	5 10 0

COALS.

NEWCASTLE. Unscreened.	s.	d.	
Tyne Main	5	6	per ton.
Ravensworth Pelaw, Dean's Primrose	5	9	„
Pelton, Brancepeth, Medomsley, New Tanfield	6	0	„
Pelaw	6	3	„
Eighton Moor, Felling Main, New Pelton, Peareth, South Pelaw, Waldridge, South Peareth	6	6	„
Ramsay's Cannel	13	0	„
Cowen's Cannel	13	0	„

DERBYSHIRE. Unscreened.	s.	d.	
Clay Cross, Deep Main, New Birchwood	6	6	per ton.

SCOTCH CANNEL.			
Kirkness best	23	0	„
Capeldrae, first quality	20	0	„
Ditto, second quality	10	0	„
Lothian	18	0	„
Lesmahago at Glasgow	16	6	„
Ditto at Leith	18	0	„
Wemyss	15	0	„
Dombristle, Luthans	12	0	„
Bridgeness, Kinneil	11	0	„
Lochgelly, Lumphinan	10	0	„

FIRE GOODS.

Best Fire Bricks, 50s. per thousand, at Newcastle.
Do. Clay, 12s. per ton do.

WROUGHT IRON TUBING, subject to 40 per cent. Discount.

	2 inches.	1½ inch.	1¼ inch.	1 inch.	¾ inch.	½ inch.
	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.
Patent welded tubes, from 4 to 12 feet, per foot	1 8	1 0	0 10	0 7	0 5	0 4¼
Ditto „ 2 to 4 feet	One	penny	per foot	extra.		
Ditto „ 6 in. to 18 in., each	3 0	2 0	1 9	1 3	1 0	0 9
Connecting pieces, or long screws	3 6	2 3	2 0	1 6	1 2	0 11
Bends, springs, and elbows, wrought iron	3 9	2 3	1 9	1 0	0 10	0 8
Tees, wrought or cast	4 0	2 6	2 0	1 6	1 1	0 10
Crosses, wrought or cast	4 6	3 0	2 6	2 0	1 6	1 2
Iron cocks	17 6	9 6	7 6	4 6	3 3	2 6
Ditto, with brass plug	28 0	16 0	13 0	7 0	5 6	4 6
Diminishing sockets, caps, plugs, and nipples	1 3	0 9	0 8	0 6	0 5	0 4
Plain sockets	1 0	0 8	0 7	0 5	0 4	0 3
Flanches	1 9	1 6	1 3	1 0	0 9	
Syphons, 2 quart	15 0	14 0	13 6	13 0	12 0	

FREIGHTS, per Ton.

Coastwise—Newcastle.	s.	d.
Chatham & Roches.	6	0
Cork	8	6
Dover	6	0
Dublin	9	0
Exeter Quay	8	0
Folkestone	6	6
Hastings	7	0
Ipswich	5	6
Jersey	6	0
London	6	0
Lowestoft	4	9
Lynn	6	0
Margate	6	0
Portsmouth	7	0
Plymouth	7	3
Southampton	7	6
Weymouth	8	0
Yarmouth	4	9
Foreign.		
Amsterdam	8	6
Boulogne	7	0
Barcelona	18	0
Bordeaux	11	0
Calais	7	0
Dieppe	7	6
Hamburg	7	6
Havre	8	6
Lisbon	10	6
Rotterdam	7	3
Rouen	11	0
St. Petersburgh	10	0
Stettin	8	6
Trieste and Venice	21	0